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Stones in the gall-bladder, cystic, hepatic, and common ducts (Cruveilhier).

GALL-STONES

and their

SURGICAL TREATMENT

BY

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LEEDS



Fully Illustrated

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PREFACE.

This book contains the material upon which I based a course of lectures delivered at the Medical Graduates College in London during April and May, 1904. It includes, I think, a detailed account of the etiology, pathology, clinical manifestations and operative treatment of gall-stones.

There can be no doubt that in the future surgical treatment will be adopted more frequently and in an earlier stage of gall-stone disease than has hitherto been customary. The great and increasing importance of the subject is, therefore, a sufficient warrant for the publication of a work of this size.

I desire to tender my thanks to the authorities in charge of the museums at the Royal College of Surgeons of England, at Guy's Hospital, University College Hospital, King's College Hospital, and Charing Cross Hospital, for permission to photograph the specimens in their charge.

My friend, Dr. E. B. Hulbert, is responsible for the selection of these photographs, and I am greatly indebted to him for the help he has afforded me.

The coloured and black and white drawings have been made by Miss Ethel Wright. I consider myself fortunate in having the assistance of so able an artist.

B. G. A. MOYNIHAN,

33 PARK SQUARE, LEEDS,
August 16, 1904.



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GALL-STONES

AND THEIR

SURGICAL TREATMENT.

CHAPTER I.

ANATOMY OF THE GALL-BLADDER AND DUCTS.

The gall-bladder in its normal condition is pear-shaped, and measures approximately 3 to 4 inches in length and $1\frac{1}{4}$ inches to $1\frac{1}{2}$ inches in width at the fundus, having an average capacity of $1\frac{1}{2}$ ounces. It lies obliquely, the fundus being directed downwards, slightly forwards, and to the right, and touching the anterior abdominal wall at the meeting of the outer border of the rectus and the costal arch. This point corresponds almost exactly with the tip of the ninth rib. In the liver-edge there is often a slight notch opposite the gall-bladder—the *incisura vesicalis*. The neck of the gall-bladder is directed upwards, backwards, and to the left. All the fundus is covered by peritoneum, but above this there is a bare, uncovered surface which lies in contact with the liver in the fossa for the gall-bladder. The extent of the peritoneal investment varies much in different individuals. In approximately five per cent. of bodies examined a



FIG. 1.—The gall-bladder, bile-ducts, etc., dissected from behind. The upper small figure shows the reticulations of the mucous membrane of the gall-bladder.

distinct mesentery exists, so that the gall-bladder can move, pendulum like, in the abdomen. The posterior relations of the gall-bladder are, from below upwards, the transverse colon, the duodenum, and perhaps the pyloric end of the stomach. As the gall-bladder narrows to the cystic duct its walls become slightly thicker, and an S-

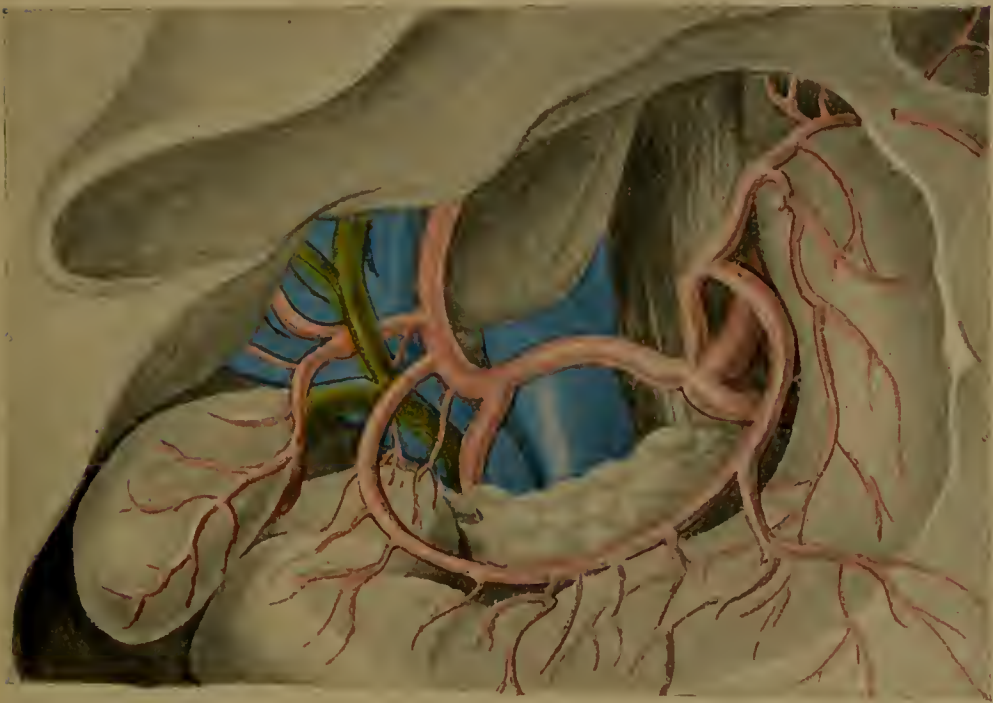


FIG. 2.—Anatomy of the gall-bladder and ducts. Diagram altered from Quain to show the vessels.

shaped curve is formed. Bevan has pointed out that this curve can be entirely straightened out by dividing the peritoneum and connective tissue around the neck of the gall-bladder and the cystic duct. It is just beyond the first turn of this curve that a stone may be impacted. It is then a matter of great difficulty to force the stone backwards into the gall-bladder in order to remove it.

20 Anatomy of the Gall-bladder and Ducts

At the commencement of the cystic duct there is a valvular projection of the mucous membrane which can be clearly seen by looking into the duct from the opened gall-bladder. There is a series of similar valvular projections arranged along the whole length of the cystic duct. The valves are infoldings of the mucous membrane and are crescentic in shape; they are placed alternately upon the one side and upon the other of the duct. It is generally said that they



FIG. 3.—Gall-bladder, bile-ducts, hepatic and cystic artery, and portal vein (after Cabot).

are arranged “in spiral fashion” in the duct, but this is erroneous. The upper two, three, or four valves are constant and well-marked. Below these the valves are often imperfectly formed or irregularly placed. These are known as “the valves of Heister.” The cystic duct is about $1\frac{1}{2}$ inches in length, and it runs downwards and to the left between the layers of the lesser omentum to join the common hepatic duct in forming the common bile-duct. The cystic artery lies close to the cystic duct,

being above and very slightly to the inner side. In cutting across the cystic duct, close to the common duct, other small unnamed branches of the hepatic artery may be wounded. The average diameter of the cystic duct is given by Bevan as $\frac{1}{8}$ inch; it is, therefore, the narrowest of all the bile-ducts. The common hepatic duct formed by the junction of the right and left hepatic ducts is about 2 inches in length and one-sixth of an inch in diameter, being slightly wider below than above; it runs downwards and to the right in front and to the right of the portal vein. The hepatic artery lies to its left.

The common bile-duct

is slightly more than 3 inches in length, and extends from the point of its formation at the junction of the cystic and hepatic ducts downwards and slightly to the right, to



FIG. 4.—The cystic, hepatic, and common ducts (Testut).

end with the canal of Wirsung in the ampulla or diverticulum of Vater. The ampulla of Vater opens upon a papilla, the "papilla major" of Santorini, which can be felt as a small shot in the mucous membrane of the second portion of the duodenum, about 4 inches from the pylorus. Examined from the opened duodenum, the termination of the common duct and of the pancreatic duct is difficult to see. It is far more readily recognised by touch. The papilla is, however, generally placed upon a vertical ridge of mucous membrane, the plica longitudinalis, which is readily distinguished from the valvulæ conniventes, whose folds run at right angles to it. The lower part of this fold, that below the papilla, is always better marked than the upper part, which may be entirely absent. This lower part is sometimes described as the "frænum carunculæ." The relations of the common duct are surgically of the greatest importance.

Three portions of the duct may be described:

1. Supraduodenal.
2. Retroduodenal or pancreatic.
3. Transduodenal or interstitial.

The first, or supraduodenal, portion is approximately $1\frac{1}{4}$ inches to $1\frac{1}{2}$ inches in length. It extends from the formation of the common duct by the junction of the cystic and hepatic ducts to the posterior surface of the duodenum, where it comes in contact with the pancreas. This portion lies in the free edge of the gastro-hepatic omentum; to its left is the hepatic artery, and behind both lies the portal vein. Along the duct are two, three, or four lymphatic glands. The gastro-hepatic omentum containing these

structures, in addition to lymphatic vessels and nerves, forms the anterior boundary of the foramen of Winslow. In a normal subject the foramen will permit the passage of two fingers, but in patients who have suffered from



FIG. 5.—Shows the structures in the gastrohepatic omentum and a transverse section at the level of the foramen of Winslow (Testut).

cholelithiasis the foramen may be narrowed, or even entirely obliterated by adhesions.

The second, or retroduodenal, or pancreatic portion is about 1 inch to $1\frac{1}{4}$ inches in length. It lies in close contact with

the pancreas, being either in a groove or within a canal in the substance of the gland.

The exact relationship of the common bile-duct to the head of the pancreas is of the greatest importance. Helly has studied the relationship in 40 cases. He finds that the lower end of the duct is in contact with the gland for a distance varying from 2 to 7 cm. In 15 cases (equivalent



FIG. 6.—The portal fissure, showing the cystic and hepatic ducts, the portal vein, the branches of the hepatic artery, and lymphatic glands (Testut).

to 37.5 per cent.) the duct was placed in a groove on the posterior surface of the pancreas; in 25 cases (equivalent to 62.5 per cent.) the duct was completely surrounded by the substance of the gland.

Bunger (*Beit. z. klin. Chir.*, Bd. 39, Heft 1) has made dissections in 58 subjects. In 55 he found that the common bile-duct ran through the substance of the pancreas,

and in only 3 was it uncovered. The average length of its course through the gland was 2 em.

In 20 cases in which I dissected out the whole length of the common duct I found in every instance that the pancreas, after dissection, hid some part of the common duct



FIG. 7.—The common bile-duct, seen from behind.

from view when looked at from behind. The separation of the duct from the tissue of the pancreas could be effected in 7 without any apparent damage to the structure of the gland, the duct lying in a groove therein; in 13 the duct was so embedded that the lobules of the gland had to be divided before the common duct could be exposed.

26 Anatomy of the Gall-bladder and Ducts

It may, therefore, be stated that in two cases out of three, on the average, this portion of the common duct is surrounded completely by the tissue of the pancreas, and that to reach the duct from behind, the substance of the gland would have to be divided.

The third, or transduodenal, or interstitial portion in the duct comprises that portion which, passing obliquely

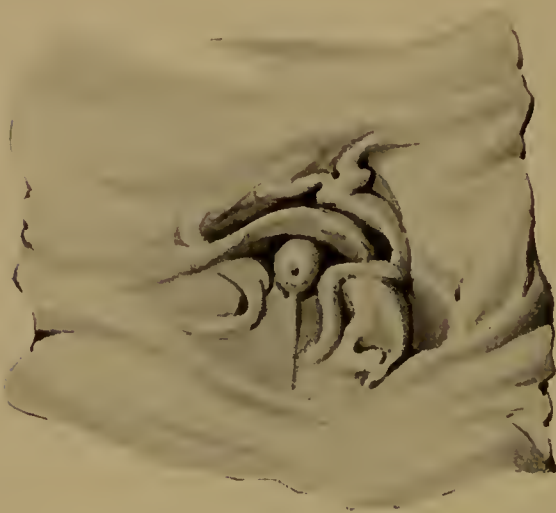


FIG. 8.—The papilla of Vater seen from the duodenum. Note the overhanging fold and the vertical ridge, the frænum carunculæ.

through the wall of the second part of the duodenum, on its inner and posterior aspect, ends in the diverticulum of Vater. It is about $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in length.

The common duct at its termination is in relationship with the duct of Wirsung. As a rule, both ducts end

in the base of a conical cavity whose apex opens into the duodenum upon a papilla. The conical cavity is termed the diverticulum of Vater. Its length varies, according to Testut, from 6 to 7 mm., and its breadth from 4 to 5 mm. Opie measured the length of the diverticulum in 89 specimens. In 11 specimens in 100 no diverticulum existed. It varied from zero to 11 mm.; its average was 3.9 mm. In only 30 instances was the length of the diverticulum 5 mm. The opening of the ampulla upon

the surface of the papilla is narrow—narrower than any portion of the duct. Opie found the average diameter of the orifice to be 2.5 mm.

The actual size of the diverticulum and the relative size of the diverticulum and of its opening upon the surface of the duodenum are of great importance from a surgical standpoint, for if the diameter of the opening, for example, be 3 mm., and a calculus 4 mm. in diameter



FIG. 9.—Absence of ampulla of Vater, showing separate openings of common duct and duct of Wirsung on the papilla.

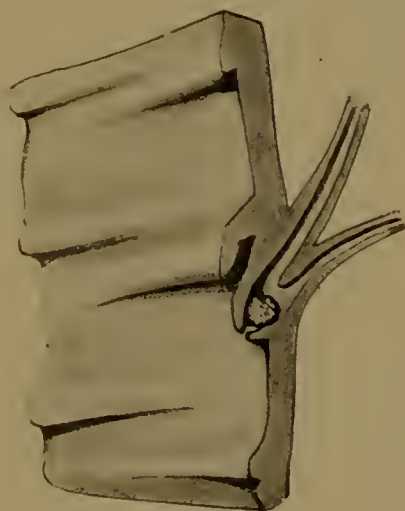


FIG. 10.—Ampulla of Vater with termination of common duct and duct of Wirsung.

reach the ampulla from the common duct, it may block the duodenal orifice, being unable to pass, and will, therefore, convert the common bile-duct and the pancreatic duct into a common closed channel. These are the conditions which, as shown by Opie, determine the incidence of acute pancreatitis by allowing a retrojection of bile from the common duct into the canal of Wirsung.

The termination of the two ducts in the ampulla is surrounded by circular muscular fibres—the so-called “sphincter of Oddi.” These fibres are continuous with the longitudinal muscular fibres on the ducts.

Variations from this normal condition of the ampulla are not common. The two ducts may open separately into the duodenum, or the canal of Wirsung may partially surround the lower end of the duct, being gutter-shaped, or the papilla may be absent, and in its place a depression may be seen on the duodenal wall.

Diameter of the Duct.—The duct gradually narrows from its beginning to its end. According to Padula (Brit. Med. Journ. Supplement, Feb. 27, 1904, p. 34), the first portion attains, with the distension which produces injection on the cadaver, a diameter of 7, 8, or even $8\frac{1}{2}$ mm.; the second portion is never wider than 5 mm., and the third portion than $3\frac{1}{2}$ mm. A gradual lessening of the diameter of the common duct is therefore one of the causes of impaction. A stone which would pass along the first inch of the duct would become wedged in the lower and narrower portion.

Access to the common, cystic, and hepatic ducts can be best obtained by freeing them from adhesions, introducing the finger into the foramen of Winslow, and, by gentle forward traction, fixing that part of the bile tract into which an incision is to be made.

The lower part of the common duct can be reached in one of two ways, retroduodenal and transduodenal. In the former, the duct is opened from behind, access being obtained by dividing the parietal peritoneum to the right of the descending portion of the duodenum. The peri-

toneum to the left of this incision is stripped up until the duodenum is reached, and it will then be found a simple matter to turn the second portion of the duodenum over to the left. It is possible, in fact, to mobilise this portion of the gut, reproducing that condition of free duodenum which



FIG. 11.—Common duct seen from behind, showing lymphatic glands along the cystic and common ducts.

is normal in foetal life. The posterior surface of the duct is thus reached. The transduodenal route opens up the second portion of the duodenum and exposes the papilla. The lower end of the duct may be defined by passing a director upwards along the duct, and by slitting the mucous membrane upon this. If only the lower end of the duct—

that portion which lies within the wall of the duodenum—is opened, there is no need for the introduction of stitches.

The walls of the gall-bladder and the ducts consist of peritoneum, which forms only a partial investment of a layer of fibrous and muscular tissue intermixed, and of an inner layer of mucous membrane, covered with columnar epithelium. The mucous membrane of the gall-bladder presents a finely honeycombed appearance.

Lymphatic Glands.—The position of the lymphatic glands around the bile tract is a matter of some importance. Mascagni described a gland as being constantly present at the neck of the gall-bladder where the S-shaped turn is being made to the cystic duct. This gland is frequently but not invariably present. Quénu describes two constant glands, one larger, on the outer side of the common duct, at its commencement, and one smaller, a little higher up, in the angle between the cystic and hepatic ducts. A chain of four or five glands lies along the common duct. These glands by their enlargement may cause a blockage in the ducts, or at the outlet from the gall-bladder, and they may, when enlarged, be so firm and hard as to persuade the operator that a stone is surely present in the duct. Dr. Brewer has recorded a case of Hodgkin's disease in which the enlargement of the glands along the common duct caused all the symptoms of obstruction of the common duct, so that an erroneous diagnosis of malignant disease was made.

CHAPTER II.

VARIETIES OF GALL-STONES.

Naunyn has suggested the following classification of gall-stones:

1. *Pure Cholesterin Stones*.—These are hard, oval or spherical, smooth, pure white or yellowish, and translucent, rarely brown or green in colour. They are generally of the size of a cherry or larger. On section, they appear white and crystalline throughout; on fracture a radiating striation is generally visible.

2. *Laminated Cholesterin Stones*.—These are generally hard, but they become fissured and cracked on desiccation. The surface may be variously coloured. In size and form they resemble the first variety, but they are more often distinctly faceted. On section they are laminated. They consist of 90 per cent. cholesterin; in addition they contain small quantities of bilirubin-calcium and biliverdin-calcium, and carbonate of soda.

3. *Ordinary gall-bladder stones*—of various sizes, shapes, and colours. They rarely grow larger than a cherry and are generally much smaller. They are faceted and of a brown or yellow or rarely of a greenish colour. When first removed, they are soft and compressible, but as they dry they shrink and become hard. They have a hard shell and a soft kernel. No crystalline structure is visible.

4. *Mixed Bilirubin Stones*.—These are usually as large as a cherry or even larger. They occur as solitary stones or in numbers of two, three, or more, and are found in either the gall-bladder or the ducts, generally in the former. On drying, an outer layer or layers may peel off like a rind. The nucleus, and sometimes the shell, consists chiefly of cholesterin; the rest of the stone consists of bilirubin-calcium.

5. *Pure Bilirubin-calcium Calculi*.—Of these there are two varieties:

- (a) Solid black-brown coneretions with a nodular surface, generally compressible and eonglomerate.
- (b) Harder stones, often spindle-shaped, showing a metallic lustre on crushing.

6. *Rarer Forms*:

- (a) Amorphous stones, resembling pearls.
- (b) Chalk stones, very hard and prickly or smooth and often containing a hollow in the centre.
- (c) Concretions formed around foreign bodies, such as a worm of the species *Anguillula* (Lobstein), a piece of *Distoma hepaticum* (Bouisson), a needle (Nauehe), the kernel of a plum (Frerichs), small parties of mercury (Frerichs), silk or catgut sutures (Homans, Kehr).
- (d) Casts of the bile passages.

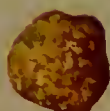
Gall-stones may be single or multiple. A solitary calculus may be found in the gall-bladder, in the cystic duct, or in any part of the hepatic or common ducts. A single calculus, when discovered during operations, is nearly always impacted at some part of the bile passages. As a rule, calculi are multiple, and the number



1



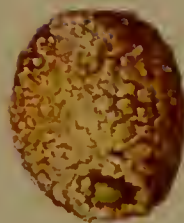
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3



4



5

FIG. 12.—GALL-STONES.

1, Almost free cholesterin; 2, cholesterin and bilirubin-calcium; 3, a stone removed from the ampulla of Vater; 4, a stone removed from the common duct; 5, a stone removed from the cystic duct.

of them is sometimes astonishing. The largest number I have removed is 1885. The patient was a man aged thirty-eight, who suffered also from duodenal ulcer, with



FIG. 13.—Small black tuberculated calculi of bile-pigment embedded in mucus, the whole removed by operation from the gall-bladder of a patient from whom a small ulcer of the stomach was excised. From a patient aged fifty-five, who had suffered for several years from indigestion, and who then began to experience severe pain about an hour after food, and to lose flesh. A doubtful tumour could be felt, and during attacks of pain the stomach hardened under the hand. Free HCl was found present after a test-meal. On exploration the swelling was found to be a greatly thickened pylorus, and along the lesser curvature was a "tumour," which, on opening the stomach, proved to be thickening due to a chronic ulcer. The latter was excised and the edges closed by suture. Posterior gastro-enterostomy was next performed, and the gall-bladder emptied of the material shown in the specimen and drained. Complete recovery. (Royal College of Surgeons' Museum, No. 283 Og.)

hæmatemesis and melæna. For this, gastro-enterostomy was performed. As a matter of routine, I explored the gall-bladder and found it packed with small stones, the average size being equal to that of a mustard seed. There

had been no mention of symptoms of gall-stone colic before the operation, and on subsequent enquiry nothing that could not be accounted for by the duodenal ulceration was elicited. Larger numbers of stones have been found on postmortem examination. Thus Frerichs, in a woman sixty-one years of age, found 1950 stones, Dunlop (*Lancet*, 1878), in a woman of ninety-four, found 2011, Morgagni 3000, Hoffmann 3646, Langenbuch 4000, Naunyn 5000, and Otto 7802. As a rule, it may be said that the fewer the stones, the larger their size, and the more numerous the stones, the smaller are they. Two or three large stones may be present and smaller stones may then be found with them in hundreds. If many small stones are present, they are generally rounded in shape and smooth on the surface, but when the stones are larger than mustard seeds, the pressure of one against another causes facetting.

The largest gall-stone I have removed had caused intestinal obstruction. Its diameter was $1\frac{1}{2}$ inches. Stones of a size far greater than this are sometimes found. Meckel describes, in the *Transactions of the Berlin Academy*, one which was 15 cm. long and 6 cm. thick; it completely filled an enlarged gall-bladder. Another large stone is depicted by Hutchinson in the *Archives of Surgery*, July, 1891, and by Mayo Robson (*Diseases of the Gall-bladder and Bile-ducts*, second edition, page 151). It weighed 3 ounces 5 drams.

When a number of stones are present in the gall-bladder they are, as a rule, of the same formation. Hein found variations in the chemical constitution in 28 out of 632 cases.

In 326 cases of gall-stones of which Riedel possessed accurate information, in 56 there was 1 stone; in 29 there were 2 stones; and in 17 there were 3 stones. The stones were few in number, were generally large in size, and *vice versa*.

THE FORMATION OF GALL-STONES.

From the days of Galen up to comparatively recent times the belief was universal that gall-stones were the result of the coagulation of bile, induced by the increase of heat in the liver.

Morgagni, and, after him, Meckel von Hemsbach, attributed a causative influence to a chronic catarrh of the mucous lining of the gall-bladder and bile-ducts. The recent investigations of Naunyn, Gilbert, Mignot, and others have thrown light upon many of the circumstances necessary to the formation of gall-stones in animals and in men.

The two chief constituents of gall-stones are cholesterin and bilirubin-calcium. The origin of these two substances seems now to be definitely settled. Budd, in 1845, was the first to suggest that the cholesterin of gall-stones was derived from the mucosa of the gall-bladder. Bristowe, in 1887, supported this view, and Naunyn gave it strenuous advocacy in 1892. It has now been shown, by much careful work, that these two substances are derived from the mucosa of the gall-bladder; that for their production certain alterations are necessary, such, for example, as slight inflammation with desquamation of the epithelium (a condition which Meckel

called "lithogenous catarrh"), and that in all probability this change is accompanied by an increased outpouring of mucus from the glands.

In the great majority of cases, therefore, gall-stones are formed in the gall-bladder. When found in the ducts, even in the hepatic ducts, or the intrahepatic ducts, they are formed in the gall-bladder and have migrated thence. Gall-stones may, however, without question, form in the ducts primarily, as, for example, in the intrahepatic ducts in cirrhosis of the liver.

The slight forms of cholecystitis necessary to the formation of gall-stones may be produced by the injection of chemical irritants into the gall-bladder, or by the introduction of micro-organisms.

Herter (Med. News, Sept., 1903) has found that the injection of bichloride of mercury, carbolic acid, or ricin into the gall-bladder resulted in a marked increase in the cholesterin in the bile. The gall-bladder walls were usually thickened (especially in the bichloride series) and showed considerable proliferation and desquamation of epithelium, together with congestion of the vessels of the submucosa. The bile remained sterile.

Bacteria.—During the last few years much attention has been given to the influence of bacteria in the production of gall-stones. The microbial origin of biliary and other calculi was first suggested in 1886 by Galippe. In 1890 Welch found the bacillus coli and the staphylococcus pyogenes in gall-stones, and in 1896 Hanot and Milan discovered the bacillus typhosus.

It was formerly thought that the bile possessed a mild, though perhaps an important, antiseptic action.

Létienne (Arch. de Med. Exp., 1891), Mieczkowski (Mitt. aus den Grenzgeb., Bd. 6), and others, however, found that micro-organisms could be readily cultivated in normal bile, though their rate of growth was not so rapid as in broth. The bile of all animals and of man is said, under normal circumstances, to be sterile. Rettger, working under the direction of Herter, made cultures from the bile of six healthy dogs, with negative results in every instance. Erhardt divided the common or hepatic ducts in several animals and allowed the bile to flow freely into the peritoneal cavity. No signs of peritoneal sepsis resulted; the animals died after a few days of cholæmia. If, however, the bile was first infected by the bacillus coli, a septic peritonitis rapidly developed and proved fatal. Fraenkel and Krause (Zeit. f. Hygiene, Bd. 32) opened the gall-bladder in guinea-pigs and rabbits, and allowed the bile to flow freely into the peritoneal cavity, without causing infection. Miyake found no organisms in the bile, in the gall-bladder, cystic and hepatic ducts, in 75 animals out of 76. He further showed that the lower portion of the common duct, and the ampulla Vateri in particular, invariably contained organisms, especially the bacillus coli. In dogs and in rabbits Netter and Duclaux found the lower part of the common duct to be inhabited by bacteria, the rest of the bile passages being sterile. Naunyn and Gilbert found the bile from the gall-bladder removed after death to be sterile. These results, however, have not been invariably confirmed by other investigators. Ehret and Stolz (Mitt. a. den Grenz., Bd. 7), using large quantities of bile, so as to increase the likelihood of the

discovery of organisms, found that the bile was sterile in only about one-half of the cases examined. Fraenkel and Krause examined the bile in 125 autopsies. In 105 cases the bile was sterile. Of these 128, 36 patients were tuberculous. In 34 of these the bile was sterile on examination by ordinary culture methods. Eleven guinea-pigs were injected with the bile from these patients, and five well-marked tuberculous lesions were excited. It is, therefore, possible that though the usual culture tests may fail to reveal the presence of micro-organisms, they may, nevertheless, be present, though they are probably few in number and of very slight virulence. Very few investigations have been made from the healthy human bile removed during life. Mieczkowski collected the bile from 15 cases operated upon for diseases other than cholelithiasis. In all it was sterile. In 23 cases operated upon for gall-stones the bile was infected in 18. Petersen also found that in 50 operations for gall-stones bacteria were present 44 times; in 36 the bacillus coli alone was found; in 6 it was found in association with the staphylococcus aureus, and in 4 with the streptococcus pyogenes.

Hartmann (Deut. Zeit. f. Chir., Bd. 68, p. 207) examined the bile in 46 cases of cholelithiasis treated by operation. In 36 bacteria were found; in 10 the fluid was sterile. In 23 the bacillus coli alone was found; in 3 the staphylococcus pyogenes albus and aureus; in 2 streptococci; in 1 the staphylococcus pyogenes albus; in 2 the bacillus coli with staphylococcus; in 3 streptococci, with other organisms. Bacteria were found in larger numbers in the bile removed from the common duct in cases of calculus in the duct. These investiga-

tions refer to the micro-organisms found in the bile, not to those found in the gall-stones. The absence of the bacillus typhosus is, therefore, not so remarkable as it might seem.

In ordinary health it is probable, therefore, that the human bile is sterile, but, as Herter says, "Bacteria are likely to be present in human bile when there exist pathological conditions in parts remote from the gall-bladder." He points out, further, the difficulty of discovering such organisms as the pneumococcus and the tubercle bacillus, which renders it possible that the bile may appear to be sterile when in reality it is infected. The bile remains sterile, however, only so long as it flows unhindered through the ducts. Charcot and Gombault first showed that as soon as the outward flow of bile was hindered by ligature of the common duct the bile above the obstruction became infected. Sherrington showed that when the bile is not escaping freely from the common duct an ascending infection from the duodenum speedily occurs.

The connexion between typhoid fever and biliary infection has been closely studied since Bernheim, in 1880, first called attention to it. Hanot and Milan, in 1896, found the bacillus typhosus in the centre of gall-stones of recent formation in the gall-bladder. Chiari, in 1893, found the typhoid bacillus in the gall-bladder in 19 out of 22 cases of enteric fever, and Cushing, in 1898, found that in 50 per cent. of patients who died of typhoid fever the organism could be found in the bile removed from the gall-bladder. Ehret and Stolz compiled a table of 32 cases of typhoid cholecystitis which were treated by operation or recognised at an autopsy. Of this number in no

less than 20 were gall-stones present. Chauffard found that 20 per cent. of cases of cholelithiasis gave a history of a previous attack of typhoid fever, and Cushing found that 30 per cent. of the patients operated upon at the Johns Hopkins Hospital had previously suffered from this disease. Cushing further called attention to the fact that in typhoid fever there may be an active agglutinative serum reaction towards the bacillus typhosus and the colon bacillus isolated from the gall-bladder. The bile may share the agglutinative properties of the serum.

Richardson, in a case of cholecystitis, found the typhoid bacillus clumped "as if a gigantic serum reaction had taken place in the gall-bladder." In examining the bile in fatal cases of typhoid fever he found large clumps of bacilli in five cases out of six; in the sixth case the blood serum had no agglutinative property. He injected 0.5 c.c. of typhoid bouillon culture, in which clumping had been produced by the addition of typhoid serum, into the gall-bladder of one rabbit; into the gall-bladder of a second rabbit he injected two drops of ordinary bouillon culture of typhoid bacilli; a third rabbit was used as a "control." Four months later all the animals died. In the first rabbit the gall-bladder was contracted and a rounded concretion was found within it; in the second nothing was found; in the third there were a number of round bodies arranged in concentric rings.

The extraordinary endurance of typhoid organisms in the gall-bladder and bile-ducts is shown by cases recorded by Droba (Wien. klin. Woch., 1899, No. 46) and Hunner (Johns Hopkins Hosp. Bulletin, 1899). In the

former the bacillus was found seventeen years after typhoid fever, and in the latter a purulent collection beneath the right costal margin contained the bacillus of Eberth eighteen years after the occurrence of typhoid.

Successful attempts to cause gall-stone formation in animals have now been made in a large number of cases. The priority in this matter belongs to Gilbert, though Mignot, in 1897, preceded him in the publication of results. In 1893 Gilbert and Domenici had noticed in the gall-bladder of a rabbit in which cholecystitis and cholangitis had been produced the presence of "petites concrétions verdâtres," but it was not until January 29, 1897, that they obtained a small stone from the gall-bladder of a dog that had been infected with the bacillus coli. Gilbert and Domenici had discovered, in 1894, the presence of organisms, both living and dead, in one-third of the gall-stones examined by them. Their observations were confirmed by Hanot, Létienne, and others. The possibility of the penetration by organisms of stones already formed was mentioned by Gilbert and Fournier. Gilbert in a later communication has said that the formation of gall-stones may be protective in character, an offending and irritating organism being encapsulated and embedded in an innocuous material.

The injection of virulent micro-organisms into the gall-bladder is not sufficient to induce the formation of gall-stones in the great majority of experiments. As a rule, an acute cholecystitis is aroused, and the mucosa is so damaged by inflammation and ulceration that the overproduction of cholesterin is entirely prevented. In purulent cholecystitis occurring in man and produced

experimentally in animals bile and the pigments of bile are entirely absent. Mignot first pointed out the necessity of using attenuated cultures. An attenuated culture when injected produces a mild, subacute cholecystitis which is peculiarly favourable to the overproduction of cholesterolin, and, therefore, to the formation of calculi. It is found to be of great advantage in making the attempt to produce cholelithiasis, to use an organism that has been cultivated for several weeks in diluted bile. Mignot in his work obtained the following results (see *Epitome*, *Brit. Med. Journ.*, 1898, p. 92, article 431):

1. Foreign bodies when introduced into the gall-bladder can stay there for an indefinite time, provided they are aseptic, without causing inflammation or precipitating the solids from the bile.

2. Foreign bodies previously impregnated with virulent micro-organisms cause a more or less intense cholecystitis and precipitate the solids from the bile. As long as the bacteria retain their virulence, however, they cannot form a calculus, but only a sediment mixed with pus. This precipitate has no tendency to cohere or to adhere to foreign bodies.

3. The bacteria must be attenuated, not virulent. This is best attained by growing them for some months in bile to which constantly decreasing amounts of broth are added. When sufficiently attenuated they are no longer pathogenic when injected into the cellular tissue of animals. By injecting these into the gall-bladder, stones are occasionally formed, but more often the bacteria are washed out into the intestine. If, however, a foreign body, especially if porous, such as cotton wool, be placed

in the bladder and fixed to its wall to prevent expulsion, a stone is formed round it with the greatest certainty. Five or six months are required for formation of a perfect calculus.

Gilbert and Fournier injected into the gall-bladder of a rabbit a culture of the typhoid bacillus attenuated by heating a bouillon culture for ten minutes at a temperature of 50 per cent. Three drops of this attenuated culture were injected; six weeks later the rabbit died. In the gall-bladder two concretions were found adherent to the mucous membrane. Sections of these showed a central whitish portion from which typhoid bacilli were obtained in pure culture; the shell was pigmented.

The organisms capable of giving rise to stones are, according to Mignot, the bacillus coli, the bacillus typhosus, the staphylococcus pyogenes, the streptococcus pyogenes, and the bacillus subtilis. More important than the individuality of the organism is its degree of attenuation.

The retention or stasis of bile is a very important factor in assisting in the formation of gall-stones. If the bile can escape freely from the gall-bladder, any organisms injected speedily find an exit. If, however, the cystic duct be tied or a foreign body placed in the gall-bladder, the organisms find a foothold. Miyake and others, in their experiments with the colon bacillus, failed to produce the formation of calculi if no other factor than the presence of microbes was in evidence. Before stones could be produced it was necessary to impede the flow of bile through the cystic duct. Ehret and Stolz also showed that a diminution of the motility of the gall-bladder, or anything tending to retard the dis-

charge of bile, favoured the growth of organisms in the gall-bladder. Mignot, in a series of experiments, introduced foreign bodies impregnated with the bacteria whose action was to be tested into the gall-bladder, and left them there. Gall-stones were found to have formed around them in the course of a few months. In another series the foreign bodies were removed at the end of four weeks by operation. In these, also, calculi were found at the end of four and five months. The stones formed in both series were comparable, 'chemically, physically, and bacteriologically,' with those found in man.

Foreign Bodies.—The influence of foreign bodies in the formation of gall-stones was first recognised in man by Homans. In a patient upon whom cholecystotomy had been performed seventeen months before a second operation became necessary on account of a return of symptoms. Seven stones were found, and five of these had formed around silk ligatures. Similar instances have been met with in the practice of other surgeons. Jacques Meyer, experimenting upon dogs, introduced small sterile ivory balls into the gall-bladder. At the end of a year a small amount of sediment was noticed in the gall-bladder, but no stone. Even when hollow balls were used there was no deposit on the inner side of the globes. Mignot combined the introduction of sterile foreign bodies with the injection of attenuated organisms. The injections were made first, and after a time the sterile bodies were introduced. After two months they were found covered with a deposit of cholesterin. In a series of 19 animals the foreign body, coated with cholesterin, was removed and the gall-bladder closed. At the end of six months,



FIG. 14.—Gall-stones crystallized around sutures (Homans, in "Annals of Surgery").

in 7 out of 19 of the animals, fine stratified cholesterin stones were found.

Italia (Riforma Medica, 1901), after a series of experiments with various organisms, stated his results in the following manner:

1. The bacillus coli and the bacillus typhosus are the specific organisms concerned in the formation of cholesterin calculi.
2. The streptococcus pyogenes and the staphylococcus pyogenes aureus are rarely the causes of gall-stone formation. When they are, the stone consists solely of calcium salts.
3. If the bacillus coli and the streptococcus or staphylococcus are present, the stone is of mixed formation, consisting of cholesterin, calcium salts, and bile pigment.
4. The bacillus subtilis grows well in bile but does not alter it in any way.

The following conclusions may be accepted:

1. The chief constituents of gall-stone, cholesterin and bilirubin calcium, are produced by subacute inflammatory changes in the mucous membrane of the gall-bladder, which result in desquamation of epithelium and in increased production of mucus.
2. The injection of a virulent culture of micro-organisms produces an acute cholecystitis, without the formation of gall-stones.
3. The injection of attenuated cultures causes no change if drainage from the gall-bladder is free.
4. Retention of bile, brought about by the introduction of sterile foreign bodies, does not cause the formation of stone.
5. If retention of bile be caused by ligature of the

cystic duct or by the introduction of foreign bodies (which cause a stasis of the bile adhering to them and between them), and an attenuated culture be injected, stone formation will occur.

6. The gall-bladder is the chief seat of the formation of gall-stones.
7. The clumping of typhoid bacilli within the gall-bladder may possibly furnish an explanation of the occurrence of cholelithiasis after typhoid fever.

All these researches seem to assume that the gall-bladder is the seat of the formation of stones, and not merely the storehouse. Doubtless this is true in great measure, but the question as to the formation of stones and as to the origin of bile of altered quality which may make the stone-building easier within the intrahepatic ducts, is worthy of closer investigation than it has, so far, received. In the smaller bile-ducts no epithelial lining is present, and therefore no overproduction of cholesterin is possible.

It is interesting to remember that gall-stones are found in the foetus, and that the intestinal canal of the foetus is sterile. The stones in the foetus are, however, softer, and seem to consist of bilirubin calcium chiefly.

An interesting case, bearing upon the question as to the time needed for the formation of gall-stones, has been recorded by Rokitisky (*Cent. f. Chir.*, 1899, p. 616). The patient was a woman, twenty-three years of age, who, at the end of the third week, in an attack of typhoid fever, showed all the signs of a suppurative cholecystitis. Six days later the gall-bladder was opened. It contained 58 cholesterin calculi. On section the stones showed a radiate arrangement and seemed to be of recent forma-

tion. The bacillus typhosus was found in the centre of the calculi and in the fluid contained in the gall-bladder. There had been no symptoms of any kind referable to the gall-bladder or to the stomach before the onset of the typhoid fever.

ENTRANCE OF MICRO-ORGANISMS TO THE BILE PASSAGES.

The organisms necessary to the formation of gall-stones in man obtain access to the gall-bladder and bile passages chiefly in two ways:

1. Along the common duct, from the duodenum.
2. By the blood current, chiefly from the portal vein.

1. *Along the Common Duct.*—The first route is probably more frequent. The fact that the bacillus coli is the most common bacterial inhabitant of the gall-bladder and of gall-stones suggests that an intestinal origin is the most likely, for this organism abounds in the intestine, though it is not, as a rule, present in large numbers in the duodenum when in a normal condition. The bacteria are normally present, as has been mentioned, in the lower part of the common duct; chiefly in the ampulla of Vater in animals; and in man, when gall-stones are present, the bacilli are more numerous in the common duct than elsewhere. Sherrington has shown (Journ. Path. and Bact., 1893) that no germs can enter the bile-duct from the duodenum so long as the bile remains normal and is expelled at regular intervals. If, however, there should be any obstruction to the flow of bile, and therefore stagnation, there is an instant invasion of organisms.

2. *The Portal Circulation.*—The view that the most

frequent route of infection is through the portal vein has recently been advocated by Lartigan (New York Academy of Medicine, 1902, quoted by Herter, Med. News, Sept. 26, 1903, p. 592). He produced inflammation of the intestine of dogs by means of various irritants. The animals were then fed on pathogenic bacteria, which were soon discovered in the bile. In some instances the cystic, in others the common, duct was ligatured previous to the feeding with bacteria.

On the other hand, Carmichael (Journ. Path. and Bact., vol. 8, No. 3, p. 276) has failed to find any evidence of infection after the injection of the bacillus typhosus, bacillus coli, and streptococci into the portal circulation of rabbits. He considers that the liver destroys the micro-organisms that reach it in this way, and that, therefore, the occurrence of biliary infection from the intestine along this path is highly improbable.

Adami, writing upon this subject, says that we may assume: (1) "That the colon bacilli in small numbers are in the healthy individual constantly finding their way into the finer branches of the portal circulation; and (2) that one of the functions of the liver is to arrest the further passage of these bacilli into the general circulation and to destroy them through the agency of the specific cells of the organ. Then if the action of the liver cells has been disabled by the toxic products of the bacteria these may reach the bile and spread through the gall-bladder and ducts."

Blackstein (Johns Hopkins Hospital Bulletin, vol. 2, p. 121, 1891) injected bacteria into the general venous system and recovered them from the bile. In these circum-

stances the organisms may have reached the liver either by the portal vein or by the cystic artery. Dr. Welch, in a footnote to this paper, expresses the opinion that the bile was not often infective in these experiments, owing to the bactericidal action of the liver cells. The infection of the bile through the portal vein, however, is not only possible in experimental work in animals, but is also probable in man, especially with the *bacillus typhosus* and with the *bacillus coli*. The importance of inflammatory or ulcerative lesions of the intestinal tract, in opening up a path for the entrance of organisms, is probably of great importance. During recent years attention has been called to the association of gall-stones and appendicitis. Ochsner, for example, has found that a little more than 35 per cent. of his patients operated upon for gall-stones had suffered from appendicitis (*Annals of Surgery*, vol. 35, p. 708). I have on several occasions simultaneously removed the appendix and performed cholecystotomy or cholecystectomy. The destructive lesions in the appendix doubtless allow of an infection of the blood in the portal system.

Gall-stones when once formed may increase in size in any part of the biliary tract in which they may chance to lie. Stones formed in the gall-bladder which have migrated into the hepatic or cystic or common ducts may there undergo a very considerable enlargement. Stones may be found in the common duct of so great a size that it is impossible for them to have passed through the cystic duct. Large calculi found in the ducts have, therefore, in all cases grown after their passage has been arrested.

The general circumstances determining the formation of

gall-stones in man are but little understood. There has been a considerable, and, so far, an unprofitable, discussion as to the part played in the causation of gall-stones by certain constitutional conditions. Herter, after a recapitulation of the evidences so far adduced, writes:

“It is plain from what has been said that there is at present no unequivocal evidence that gall-stones arise from constitutional derangements unconnected with micro-organic invasions of the gall-bladder. On the other hand, it is certain that the cholesterin of the bile can be considerably increased by local irritants unconnected with infection, and it is likely that the requisite local conditions for such increase sometimes arise through purely metabolic disorders. While gall-stones are commonly the result of local infections, we should carefully guard against the conclusion that they can never have a diathetic origin. It is at least highly probable that diathetic conditions are capable of so altering the composition of the bile as to favour materially the production of calculi in the presence of suitable local bacterial activities.”

And again:

“Derangements in general metabolism are not essential factors in the production of gall-stones. This, however, is no evidence that disturbances of metabolism which modify the composition of the bile may not, under certain conditions, play an important part in bringing on cholelithiasis.”

The stagnation of bile, the importance of which, as a factor in causing the formation of calculi, was first pointed out by Fernelius in 1554, has been attributed to a great variety of causes. Tight lacing, the production of the so-called “corset-liver,” sedentary habits, pregnancy, tu-

mours, or looseness of the kidney or of the liver, enterop-
tosis, growths in the pancreas and stomach, heart disease,
are some among many that are named. Certain alter-
ations in metabolism are also credited with influence—
such, for example, as gout, rheumatism, diabetes, and
arteriosclerosis. Frerichs supposed that long intervals
between meals caused an infrequent emptying of the
gall-bladder and therefore a stasis of bile; and Charcot
finds an atrophy of the muscle of the gall-bladder in the
aged—a fact to which he attributes some value.

Ehret has found gall-stones in four generations, and
some physicians are disposed to think that heredity
must be considered as playing a part. The number of
suggestions that have been put forward are remarkable
for their number and for their worthlessness. Much has
been written, but little is known. It is in surgery as in
finance—much poverty and much paper may coëxist.

The age and sex of the patient have doubtless great
influence upon the formation of gall-stones. The following
statistics have been published by Schröder. They are
based upon all the cases examined postmortem by v.
Recklinghausen, at Strassburg, in the years 1880–1887.
The patients were of all ages, the hospital including a
children's department:

AGE OF PATIENTS.	NUMBER OF POSTMORTEMS.	NUMBER OF CASES WITH GALL-STONES.	PERCENTAGE OF CASES EXAMINED IN WHICH GALL-STONES WERE PRESENT.
0-20	82	2	2.4
21-30	188	6	3.2
31-40	209	24	11.5
41-50	252	28	11.1
51-60	161	16	9.9
60 and over	258	65	25.2

Schröder also found that gall-stones were present in 4.4 per cent. of the male bodies examined and in 20.6 of the female. There were 115 adult women, and of these 99 had certainly borne one or more children, and in 5 the question of antecedent pregnancy was doubtful; in 11 only was there undoubted evidence that the women had never been pregnant.

Fiedler found gall-stones in 15 per cent. of female bodies examined and in 4 per cent. of male bodies; Roth in 11.7 per cent. and 4.7 per cent.; Rother in 9.9 per cent. and 3.9 per cent., respectively.

Information obtained from postmortem experience is, however, almost worthless. We learn from it nothing whatever as to the length of time a patient may have suffered from gall-stones, and therefore nothing as to the period of their incidence. More reliable information can be obtained from operation records which give the age of the patient at the time of the operation, and, approximately, the duration of symptoms.

O. Hartmann (*Zeit. f. klin. Chir.*, vol. 68, p. 230) found the average of his male patients, who earned their living by manual labour, to be at the time of operation forty years, and the period of duration of symptoms to be six years. Of the leisure class, the average age was thirty-seven, and the period of duration of symptoms nine years. In women of the working class the average age was thirty-five and one-half, and the duration of symptoms seven years; of the better class the age was thirty-seven and the duration of symptoms nine years. The time of the onset of stone was, therefore, in all classes before the age of thirty-five. In my own cases the average age of the

patients in the last 50 cases was forty-five, and the duration of symptoms five and one-half years. The time of onset, therefore, on the average was at or near the age of forty. At the Leeds Infirmary, including the cases, male and female, of all the staff, the average age of the last 50 patients was forty-nine, and the duration of symptoms six and one-quarter years.

There may, however, be an increased frequency of stone in older people which cannot be represented in any list of operations, for the occurrence of cholelithiasis in the aged may be devoid of symptoms. There are observations by Becquerel and others which go to show that cholesterin is present in the blood in larger quantities in older people than in those in the prime of life. Moreover, the increased production of cholesterin by the epithelial lining of the gall-bladder may well be a specially marked attribute of advanced age, occurring as a natural stage in the period of decadence. It is then not due to any such condition as the "lithogenous catarrh" already described, but rather to a degenerative condition, comparable, perhaps, with atheroma. When stones are formed under these circumstances their presence causes no symptoms, and therefore treatment, either by the physician or by the surgeon, is never sought. The fact, however, is undoubted, that the age of patients who seek relief from gall-stone disease by operation is nearer forty than fifty years, and that in them the onset of symptoms occurs, approximately, before the age of forty.

The occurrence of gall-stones in the new-born has been observed by Lieutaud and Valleix. The latter authority indeed is quoted by Naunyn as saying that "concretions

are somewhat frequently found in the gall-bladders of new-born infants."

An interesting paper upon "Biliary Calculi in Children," by Dr. G. F. Still, is published in the *Trans. Path. Soc.*, vol. 50, p. 151. The following details are extracted therefrom: Dr. Still finds that, including three cases of his own, there are 23 cases recorded in which gall-stones were found, either in the *fæces* during life or at an autopsy. Of the 23 cases 10 were infants who were stillborn or died within a few weeks of birth; 1 was "an infant," 4 were between three months and nine months of age, and 8 were children from three to fourteen years of age. Of the 10 cases which occurred in newborn children, 7 are stated to have been jaundiced, and in most of these the jaundice was present at birth. Abdominal pain, apparently of the nature of colic, was present in some cases, but not in all.

In one case (Bouisson) some narrowing of the ductus choledochus was also found; in another (Cuffer) the gall-bladder appeared to be shrunken. A tendency to hæmorrhage was also associated with the latter case; hæmaturia and hæmorrhage from the bowel were present during life, and hæmorrhage into the *psoas* muscle was found after death. The jaundice in these newborn infants was very intense, and in five of the cases was shown, postmortem, to be due to impaction of calculi in the bile-ducts. It is evident, therefore, that biliary calculus must be reckoned amongst the causes of *icterus neonatorum* of a severe and persistent variety, which in some cases, at least, ends fatally.

The presence of gall-stones in later infancy and in childhood has rarely been associated with any distinctive symptoms during life. The occurrence of jaundice with

colic was recorded only in one (Walker) of the 13 cases, while in another (Case 3) it was especially stated that the child had screamed much and drawn up its legs as if in pain. In the remaining 11 cases no special symptom of calculus was recorded.

The existence of pain of a special type in the abdomen is difficult to ascertain in infants and young children. Colic and intestinal disturbances are so common that any special observance of them by the mother is not likely. Pain, therefore, may have been present in other cases besides the two in which it was mentioned. The passage of calculi along the bile-duct is, Dr. Still says, "certainly an occasional cause, perhaps a more common one than we suspect, of colic in infants.

Dr. John Thomson and Dr. Still are both of opinion that in many, if not in all of the newborn cases the calculi have actually been formed during intra-uterine life. The condition present before birth which favours the production of biliary concretions is probably stagnation of bile, and Dr. Still and other writers have commented upon the peculiarly viscid character of the bile in infancy.

These theories are of interest as bearing upon the question of the formation of calculi in general. In the adult and in animals, as shown by repeated experiment, the stones are always microbic in origin. In the newborn the alimentary canal is sterile. Investigation as to the presence of organisms in the bile in these cases of gallstones is desirable.

Dr. Still's three cases are briefly epitomised:

Case 1.—C. B., female, aged nine months, was admitted

for vomiting and wasting; there were purpuric patches, but no jaundice. No symptom of colic, abdominal pain, or jaundice was noticed during the time the child was in the hospital. At the autopsy the gall-bladder was filled with golden-yellow bile; it contained 11 small calculi, angular, dull, black, and friable. The stones were surrounded by inspissated bile. Three calculi were impacted in the common duct, 1.5 cm. above the duodenal opening. The calculi consisted mainly of bile pigment.

Case 2.—M. T., female, aged eight months, died of acute miliary tuberculosis. There was no history of jaundice or abdominal pain. The gall-bladder contained some golden-yellow bile; near its neck there was a small area about 3 mm. in diameter where the mucous membrane showed superficial erosion, and adherent to this was some thick mucus, entangled in which was one of the minute calculi shown. Only three of these minute concretions were present, and inasmuch as they are barely the size of a pin's head, they are hardly worth calling calculi, but are of importance only as showing the tendency to formation of calculus. They were too minute to allow of any satisfactory chemical examination.

Case 3.—H. C., male, aged five months, died from marasmus and broncho-pneumonia. The gall-bladder was moderately full of rather dark, amber-coloured bile, and in the fundus of the bladder were three small calculi, the largest being about the size of a millet seed, measuring nearly 3 mm. by 2 mm., and being roughly oval in shape, with rounded contour, not angular. The colour was a dingy black, the consistence was very hard, but they were friable under considerable pressure. No calculi were found in the liver substance. Examination of one of these calculi showed no trace of cholesterin; the stone seemed to be made up almost entirely of bile pigment associated apparently with some carbonate, as a few bubbles of gas escaped on adding an acid.

CHAPTER III.

THE GENERAL PATHOLOGY OF GALL-STONE DISEASE.

The pathological results which follow upon gall-stone disease are of great diversity.

Cholecystitis.—In the gall-bladder their evidences are most commonly and most deeply imprinted. In the early stages there may be very slight evidences of catarrh of the mucosa, and it is said by Janowski that in this stage a hypertrophy of the muscle is recognizable. This, however, must be only in the earliest stages and must be only transitory; it is not to be discovered in any of the specimens removed by me in the performance of cholecystectomy. The existence of specimens of hypertrophy of the muscular wall of the gall-bladder to such a degree as to cause fascination is authenticated. The condition is comparable to that found in the urinary bladder. Upstanding bands of hypertrophied muscle are found, and between them there is a condition of sacculation. I can find no museum specimens showing this condition in man, though a specimen from an ox is in the Royal College of Surgeons. Schuppel describes a specimen in his possession, and Gilbert and Fournier make mention of the condition. In one specimen, which I removed by cholecystectomy, the wall of the gall-bladder, which to the naked eye was but little altered, showed microscopically a decided hyper-

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trophy of the muscular layer. This condition can, however, only be fugitive, soon giving place to lesions of degeneracy.

Brockbank has met with two cases in which the mucous

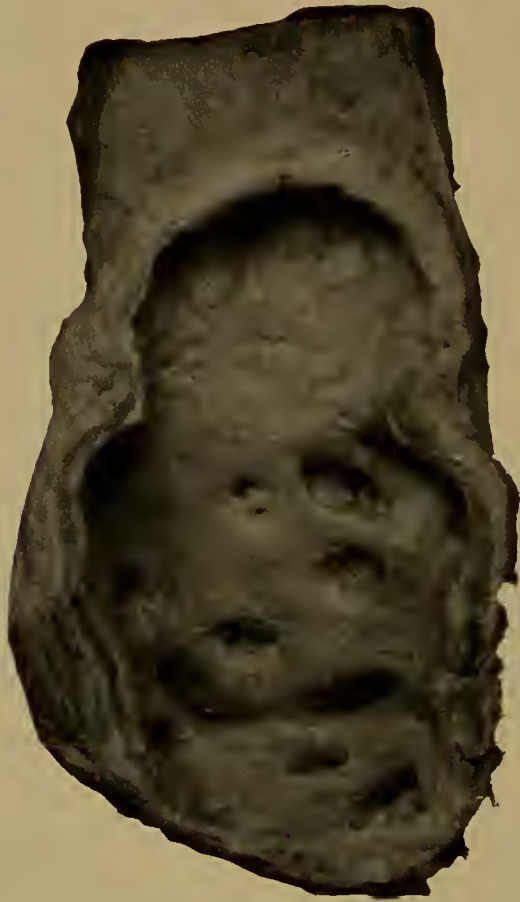


FIG. 15.—Parts of the liver and gall-bladder of an ox. No cystic duct can be traced; the coats of the gall-bladder are $\frac{1}{4}$ inch thick and show marked sacculation, such as that seen in cases of long-continued distension of the urinary bladder (Royal College of Surgeons' Museum, No. 2804).

membrane of the gall-bladder was seen with the naked eye to be dotted with many small dark specks which could be easily picked out with a sharp-pointed instrument. Microscopical preparations of these specimens showed

that the black specks were small gall-stones consisting of beautiful clear crystals of cholesterin of the ordinary type collected together in large numbers and covered in places with biliary pigment. These small cholesterin



FIG. 16.—A gall-bladder filled with gall-stones which was removed by operation, during which the muscular coat was extensively stripped from the mucous membrane, the latter being tightly stretched over the small gall-stones with which the bladder was packed. A single large stone occupied the neck of the gall-bladder, the mucous membrane of which was smooth, opaque, and thickened.

From a woman aged sixty-two. The operation was performed in June, 1899. Three years before the patient had an attack of jaundice, with pain below the shoulder-blades; this was followed by symptoms of chronic dyspepsia, and in October, 1898, by irregular vomiting. The patient very slowly but completely recovered from the dyspeptic symptoms (University College Museum, No. 1570).

gall-stones were lying in spaces in the mucous membrane which looked like retention cysts. Brockbank calls these calculi "intramucous gall-stones." A specimen (No. 1570) in the museum of University College Hospital shows a gall-bladder filled with gall-stones which was

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removed by operation, during which the muscular coat was extensively stripped from the mucous membrane, the latter being tightly stretched over the small gall-stones with which the bladder was packed. A similar embedding of stones in the mucous membrane may be seen in the common, and rarely in the hepatic, duct.

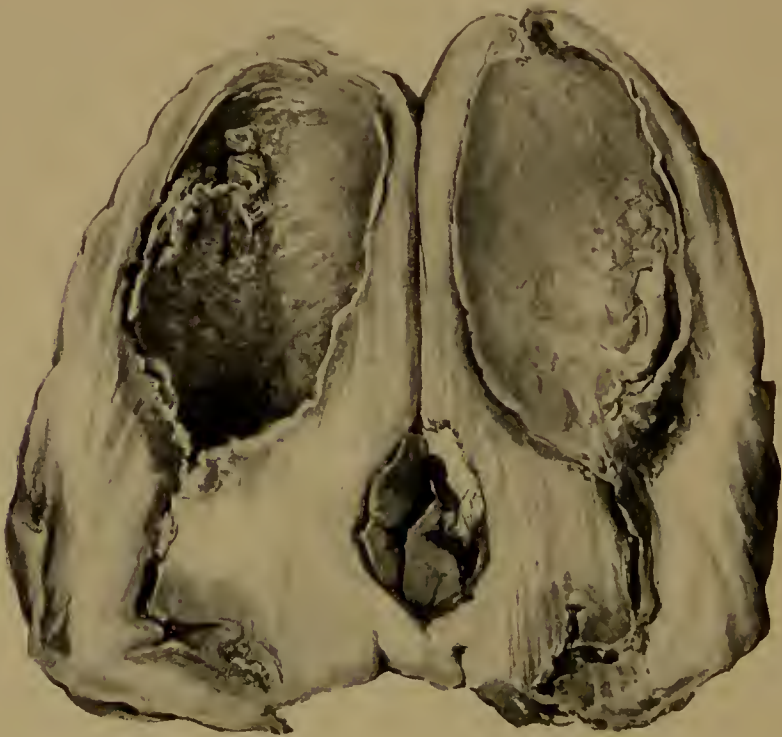


FIG. 17.—Showing ulceration of the gall-bladder and thickening more marked at the pelvis and along the cystic duct; "hypertrophic sclerosis of the gall-bladder."

It is not long before inflammatory changes are recognisable in all the coats of the gall-bladder. The mucosa becomes thickened, mottled; in parts it has shed its epithelium, and patches of ulceration are to be seen. The muscular layer disappears and is replaced by dense bundles of fibrous tissue, varying greatly in thickness. The



FIG. 18.—A dilated gall-bladder with thickened walls, containing five calculi embedded in its mucous membrane. From a man aged fifty-five who had long had fixed pain in the right hypochondrium, bilious vomiting, and occasional jaundice; after two years a tumour, increasing in size, appeared over the site of the gall-bladder. General anasarea and ascites preceded death (King's College Hospital Museum, No. 1022).

mucous coat at the first shows a thickening of the natural rugæ and microscopically an infiltration of small round cells; a hypertrophy of the glands and a vascular distension are observed. There is an abundant desquamation of epithelial cells, which, according to Gilbert and Fournier, can often be found singly or in masses in a state of degen-



FIG. 19.—A gall-bladder packed with small, flat, polygonal stones, cemented together by mucus; there were no symptoms during life (Charing Cross Hospital Museum. No. 1317).

eration in the fluid within the gall-bladder. The lesions in the mucosa are rapidly progressive. The epithelium loses its normal appearance, the cells become cubical in shape, and, according to Gilbert, a transition into pavement epithelium is found. The rugæ now begin to wither and finally disappear completely, the lining of the gall-

bladder being perfectly smooth. In a later stage a division of the gall-bladder wall into its normal layers is no longer possible; all that can be seen on the microscopical



FIG. 20.—Showing the wall of the gall-bladder considerably, but not uniformly, thickened, to $\frac{7}{8}$ inch in parts, and composed of dense fibrous tissue, with opaque whitish areas of necrosis. There are adhesions between the thin margin of the liver and the gall-bladder, the former being there invaded by new growth. From a man aged forty-four, who had suffered from pain in the epigastrium off and on since the age of seventeen. At the age of forty-four he was jaundiced for one month after an attack of pain; for two or three months before operation he had been losing flesh and failing in health. The gall-bladder and the adjacent portion of the liver were removed by an elastic tourniquet. The patient made a good recovery from the operation, but death took place three months afterwards, owing to secondary growths in the lower part of the abdomen (Royal College of Surgeons' Museum, No. 2809 a).

examination is a fibrous tissue, but little vascular, which is sometimes excessively dense, thick, and ligamentous. Such cicatricial tissue soon hastens to contract, and sclero-

sis of the gall-bladder is the final result. In the earliest stages of cholecystitis there is, according to Langenbuch, some œdema of the wall of the gall-bladder and an increased activity of secretion of the mucosa. A thin mucous fluid is poured out into the gall-bladder and then mixes with the bile. If the cystic duct be blocked, the bile, after



FIG. 21.—A thickened gall-bladder closely contracted upon a stone measuring $1\frac{1}{4}$ inches in diameter (Royal College of Surgeons' Museum, No. 2819).

a time, can no longer be discovered in the fluid, the thin mucous exudate alone being present. The serous coat is turbid, it loses its polish, and contracts adhesions with the surrounding structures. The thickness of the gall-bladder wall is sometimes remarkable, and this is more especially the case in the pelvis of the gall-bladder and at the commencement of the cystic duct. In one of my speci-

mens the section of the wall is here $1\frac{1}{2}$ inches in thickness, and the tissue is dense, white, and fibrous. Before its removal it was thought to be a malignant growth of the gall-bladder, and the whole of the gall-bladder with the adjacent portion of the liver was removed. As adhesions form to the serous coat of the gall-bladder, that surface which lies in contact with the liver becomes more firmly welded to it, and the liver substance itself becomes infiltrated with a fibrous deposit. In some cases a fatty degeneration of the liver substance is found. The changes in the liver substance in immediate contact with the gall-bladder are more marked near the cystic duct than near the fundus. In some cases the fibrous gall-bladder can be separated with little difficulty from the liver, at or near the fundus. The separation near the pelvis is, in my experience, always a matter of difficulty. When stones are placed irregularly in the gall-bladder the contour of the viscus may be greatly altered. The gall-bladder often shrinks onto the stones and fits accurately into all the irregularities of their surfaces. One of the forms not infrequently assumed by the gall-bladder is that of an hour-glass. The isthmus which separates the two compartments may be nearer the fundus or nearer the cystic duct, most frequently the latter. There may be a channel connecting the two cavities or they may be quite separate; if so, the contents of the two may be different—bile may be found in the one and pus in another.

The gall-bladder may be divided into two compartments by a septum, an hour-glass form resulting. Hotchkiss (*Annals of Surgery*, vol. 19, p. 200) gives the following

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description of a gall-bladder that was found to be in a condition of gangrene:

The interior of the bladder presented a remarkable condition in that it was almost completely divided by a thick transverse septum, which was found about $1\frac{1}{2}$ inches from the end of the fundus. This septum was complete except for a small aperture about $\frac{1}{4}$ inch in diameter near its centre. The appearance of this curious partition gave rise to the question as to whether it really was a true septum or whether the apparent cavity of the fundus might not be a diverticulum. With a view to determining this point, sections were made through the septum and through the thin walls. Mucous membrane was found absent in both sections, but the muscularis, though thinner than elsewhere, and with its bundles spread apart, was found continuous with that of the gall-bladder. This proved the lower gangrenous end of the tumor to be the fundus of the gall-bladder and not a diverticulum. The walls of the gall-bladder, as shown in both sections, but especially the walls of the middle portion, were found infiltrated with fibrin and pus. The amount of this fibrinous exudate was so great as easily to account for the great thickness of the walls of the gall-bladder, and quite sufficient to determine gangrene of the fundus.

Or there may be three compartments, or even more. Brockbank and others have described a multilocular appearance of the gall-bladder, due to the inward projection and fusion of numerous septa. By this means the gall-bladder is divided into many compartments, in each one of which a stone may be found. Such incomplete septa are seen quite commonly in cases of chronic cholecystitis. All these changes in the gall-bladder are inflammatory

in origin. The appearances described therefore vary according to the acuteness or the chronicity of any infection and according to the relative duration of each process, when both are present. In rare instances the thickened and inflamed wall of the gall-bladder may show an abundant deposit of fat, evenly distributed throughout, or placed irregularly in larger or smaller masses. In a specimen (No. 1403) in Guy's Hospital Museum the infiltration with fat measures a third of an inch in thickness, being placed between the serous and submucous coats. A similar, though slighter, condition was found in one of my own specimens of cholecystectomy.

In acute inflammation the catarrhal condition of the mucosa may go on to supuration. The whole of the wall is swollen and thickened.

Patches of ulceration are numerous, and in some of the deeper ulcers a stone may be seen to be resting. If the ulcer deepens, the stone may eventually perforate the gall-bladder wall, escaping into the peritoneal cavity, into a mass of



FIG. 22.—An adipose gall-bladder. The infiltration with fat measures a third of an inch in thickness, being placed between the serous and submucous coats. From a man aged sixty-six, who died on the day after admission to hospital. The cellular tissue throughout the body was loaded with fat; the kidneys were granular, the liver cirrhotic (Guy's Hospital Museum, No 1403).

adhesions, or into the liver substance; or if a viscus be adherent to the outer side, an internal biliary fistula may form, through which gall-stones may escape. In the more acute forms of inflammation there may be patches of gangrene in the wall of the gall-bladder, or the whole viscus may be in a condition of phlegmonous ulceration. Many such examples are quoted in the chapter on perforation of the gall-bladder. When the cystic duct is blocked, and even, rarely, when it is patent, and there is an acute virulent infection of the gall-bladder, a purulent collection speedily forms. The gall-bladder is greatly dilated, its walls are thickened, deep red in colour, sodden with inflammatory exudate, and the characteristic condition of empyema of the gall-bladder develops. This may lead to ulceration and perforation of the gall-bladder, to a general purulent peritonitis, or the whole condition may slowly subside. The gall-bladder lessens, the acute symptoms disappear, and the fluid contents are either passed into the ducts or in part absorbed. Many weeks after such an acute outburst the gall-bladder may be found to contain pus, though it is shrunken from its former size. The cystic duct is still found blocked with a calculus which all efforts may fail to dislodge.

Hydrops and Empyema.—The more chronic forms of inflammation may be associated with distension or shrinkage of the gall-bladder when the cystic duct is blocked. At the first a hydrops of the gall-bladder forms, the bile within the gall-bladder being absorbed. In hydrops the physical conditions resemble those which are found in empyema; the difference between them is due to the different degrees of virulence in the invading micro-organ-



FIG. 23. —Cystoduodenal fistula: Cholecystectomy. A deposit of fat is seen in the thickened walls.

ism. In hydrops the wall of the gall-bladder may be grossly thickened or it may be paper-thin and almost translucent. There is both an atrophic and a hypertrophic sclerosis of the gall-bladder. The epithelium is lost in patches and has undergone a process of flattening, being transformed, according to Gilbert and Fournier, into the semblance of a squamous epithelium. It has indeed undergone such an alteration as to be scarcely or not at all recognisable as having any relationship with that normally found. A distended, easily palpable gall-bladder may remain unaltered for many months, even, it may be, for years.

But the patient who bears it is in a condition of constant peril, for rupture, ulceration, or acute infection may at any moment be aroused.

The following examples give some idea of the enormous size to which the gall-bladder may attain :



FIG. 24.—Stone in the cystic duct. Hydrops of the gall-bladder.

Lawson Tait (*Lancet*, 1889, vol. 1, p. 1294) reports a case of distended gall-bladder which he mistook for a parovarian cyst. The patient was a woman forty years of age. The cyst contained eleven pints of a clear, gluey fluid, and was emptied through an incision made between

the umbilicus and the pubes. A stone was found obstructing the cystic duct.

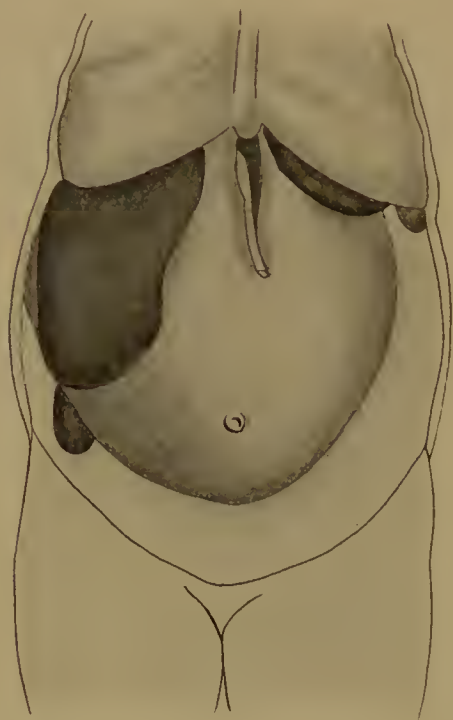


FIG. 25.—Vincent's case of dilated gall-bladder

Erdmann (*Virch. Archiv*, Bd. 43) relates the case of a man twenty-four years of age who suffered from an enormous abdominal tumour from which 60 to 80 pounds of fluid were aspirated. The analysis of the fluid shewed it to be albuminous and to contain a trace of bile. The tumour was regarded as a hydrops of the gall-bladder, due to blockage of the cystic duct.

Vincent (*Rev. de Chir.*, 1888, viii, 753) reports the following very interesting case:

A girl, eight and one-half years old, with a good family history, came to him complaining of an abdominal tumour. Six months previously her mother had noticed that the child's abdomen was larger, but the patient had complained for only three months of discomfort from the size of the tumour and the pain in it. The pain had never been acute and was rather a feeling of soreness than actual

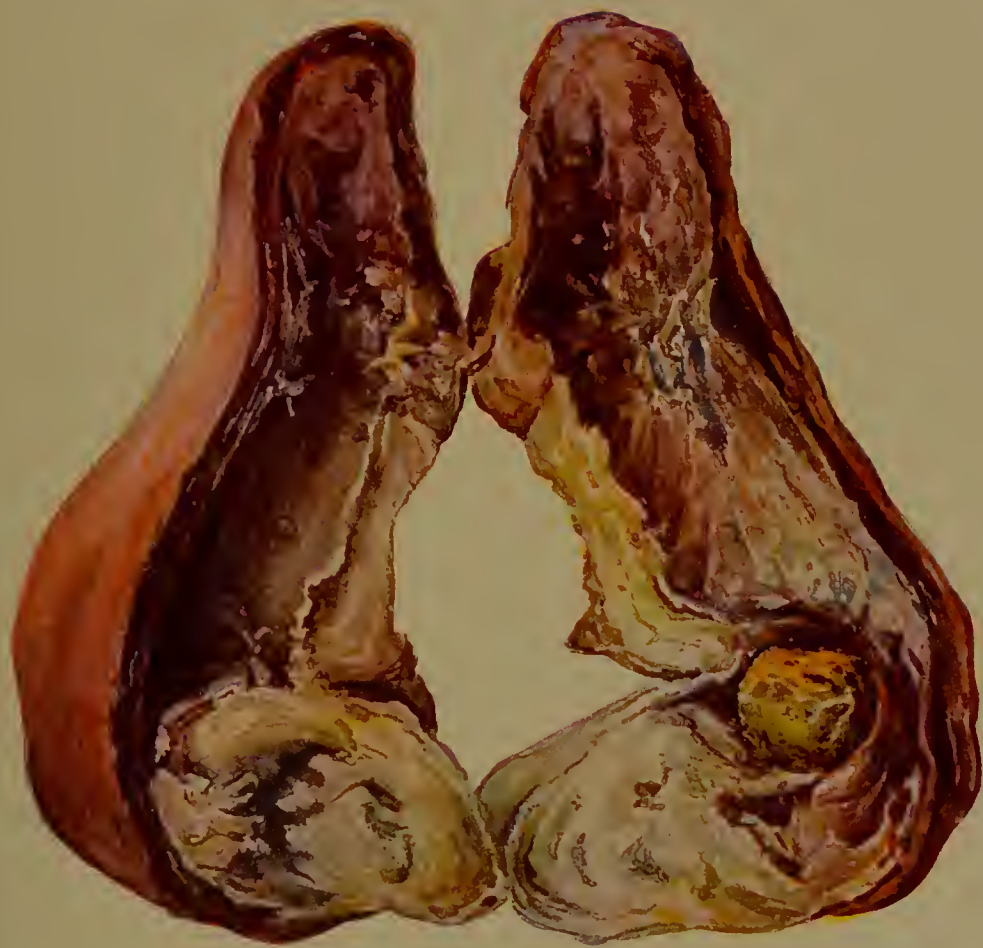


FIG. 26.—Gangrene of the gall-bladder; stone in the cystic duct.

pain. She had suffered with constipation alternating with diarrhoea. Nothing resembling gall-stones had ever been seen in the stools, and the latter had not been observed to be clay-coloured. The child was anæmic, poorly nourished, and slightly jaundiced. There was a continuous elevation of temperature of 100.5° – 102° F. The stools were hard and blackish in colour. The urine, 300–400 c.c., was albuminous and contained bile.

Examination of the abdomen showed it to be fairly uniformly distended, but rather more prominent on the right side. A ridge extended from the right hypochondriac to the left iliac region. The tumour was fluctuating, flat on percussion, and extended two fingerbreadths to the left of the median line and within three fingerbreadths of the symphysis.

The child was kept under observation some time and after aspirating the cyst, when 160 c.c. of bile were obtained, a cholecystotomy was finally done. Three litres of fluid were obtained.

The operation and the autopsy (for the child died ten days after operation) showed that the gall-bladder was tremendously dilated and hypertrophied, its walls being $\frac{7}{8}$ mm. in thickness. The cystic duct was obliterated, forming a part of the cyst wall. The hepatic duct was in the same condition and likewise helped to form the cyst; the openings of its two branches admitted the thumb. Most of the ductus choledochus also took part in the formation of the cyst, the duct being represented by a portion 15–20 mm. long, its opening into the cyst being closed by a valve-like projection of mucous membrane. While this fold of mucosa closed the duct above, a probe could be passed from below into the cyst. The pancreatic duct was ligated. The pancreas and spleen were enlarged.

Vincent considered that the trouble had arisen from the presence of a stone or lumbricoid worm in the common duct, and that after its presence had caused the dilatation

of the gall-bladder and ducts the body had passed into the duodenum. The valve-like fold of mucous membrane in the common duct had caused the continued damming back of bile.

Similar enlargements of the gall-bladder are seen in empyema—thus Berger (Bull. et Mem. Soc. de Paris, vol. 16, p. 472) operated upon a pus-containing gall-bladder which filled the right iliac fossa and measured 16 cm. by 12 cm., and Ternier, from a “slightly inflamed” gall-bladder, removed 24 litres of fluid.

If the hydrops be infected, a condition of empyema results; if it be not infected, then the gall-bladder gradually dwindles in size and eventually becomes sclerosed. In the latter case the cavity of the gall-bladder may at the last be so small as to be difficult of recognition, or it may certainly be entirely obliterated. In one example of stricture of the cystic duct the gall-bladder had become reduced to a mass of fibrous tissue less than an inch in length, and on minute examination no evidence of a cavity could be discovered.

Pericholecystitis.—The extension to the outer surface of the gall-bladder and the manifestations thereon are generally proportioned to the conditions existing within the gall-bladder. If there is acute inflammation of the gall-bladder, a local acute peritonitis results and adhesions are left behind. If there are chronic indurative conditions, the adhesions are numerous and intensely difficult to strip; they are formed quietly and without any evidence of acute infection. In rare cases the peritonitis resulting from an acutely inflamed gall-bladder may be purulent



FIG. 27.—Empyema of the gall-bladder. From a patient upon whom the author successfully performed cholecystectomy.

when no rupture of the gall-bladder is discoverable. Instances are recorded by Dilger, Jacobs, and Billinger.



FIG. 28.—A gall-bladder with thickened and calcareous walls which contained pus. From a case of typhoid fever, in the fourth or fifth week of which the suppuration is believed to have occurred (Royal College of Surgeons' Museum, No. 2806).

When the gall-stones have become quiescent in the gall-bladder the pericholecystitis which they have caused

may be the one condition which demands surgical interference, by reason of the adhesions crippling the stomach or the duodenum and thereby causing symptoms of pyloric obstruction.

Calcification.—In certain cases of long-enduring cholecystitis a calcification



FIG. 29.—A calcareous gall-bladder, the coats measuring a quarter to one-third of an inch in thickness. Its interior was filled with a soft solid substance containing a large quantity of cholesterol. There were practically no clinical symptoms (Royal College of Surgeons' Museum, No. 2823).

(it is sometimes incorrectly called ossification) of the gall-bladder may be found. In the fibrous wall of the gall-bladder smaller and larger plates of calcification are recognisable, the whole viscus seeming to be turned into a twisted mass of bone. In the earliest stages small deposits of lime salts are found only in the mucosa. In a later stage the fibrous wall of the gall-bladder is encrusted with a deposit of calcium phosphate. Pilliet, who

has examined many specimens, remarks upon the striking similarity that the process of calcification of the gall-bladder presents to that of atheroma occurring in the walls of arteries. Calcification is recognised as following a suppu-

rative cholecystitis in the great majority of cases. Complete calcification of the gall-bladder is rare, though examples are to be found in a few of the museums. Riedel records a very remarkable case in which the calcification of a gall-bladder was of such density as to require the use of a chisel and mallet before removal could be effected.

Formation of Diverticula.—One of the most remarkable of the later results of gall-stone irritation is the formation of diverticula in connexion with any part of the biliary passages. The mucous membrane is worn through by ulceration, the stone which lies in contact with it pushes the outer wall of the gall-bladder before it, and finally comes to lie in a separate compartment, which is shut off completely from the gall-bladder in some instances, but more commonly communicates with it by a narrow and often tortuous channel. The commonest site of these diverticula is in the pelvis of the gall-bladder or in the cystic duct, but the fundus, or indeed any part of the gall-bladder, may be affected. A very remarkable example of diverticulum occurring from the fundus is recorded by Staub (*Corresp. f. schw. Aertz.*, 1896). The diverticulum was opened and stones removed therefrom. Behind this was felt a tumour which was supposed to be a movable kidney, but which proved to be a distended gall-bladder. In some specimens which I have examined there was a condition seemingly of diverticulum at the outlet of the gall-bladder which, on closer examination, proved to be nothing more than the lodgment of the stone in the first part of the sigmoid turn of the cystic duct. Two of such specimens I have removed by operation. A close examin-

ation of them is necessary to distinguish them from those in which true diverticula have been formed.

If the stone ulcerate more deeply into the wall of the gall-bladder or of the ducts, a protective peritonitis may occur around the area which is being eroded from within. If, in such circumstances, the destruction of the gall-bladder continues, the stone may finally pass through the wall and come to lie in a cavity outside the gall-bladder. Such cavities are often described as "secondary gall-bladders." Very good examples of them are referred to in the article upon perforation of the gall-bladder.

In some cases the gall-bladder may adhere to the abdominal wall and stones may ulcerate through; or a tumour, resembling a malignant growth in the muscles of the abdominal wall, may be formed. Mordret records (*Bull. et Mem. Soc. de Chir.*, vol. 29, p. 1189) a case where a tumour of the abdominal wall, not adherent to the skin, was formed in this way, and Michaux refers to a precisely similar case which was under his own observation. In the former case cholecystotomy, in the latter cholecystectomy, was performed.

These diverticula may be found also burrowing in the liver substance, but in such cases it is hard to distinguish them from an actual perforation of the gall-bladder and the formation of a secondary cavity in the liver. Diverticula, which form from the cystic duct, may contain stones of large size, stones which, by their pressure, may have produced obstruction of the portal vein, of the common duct, or of the duodenum. Many examples of mistaken diagnosis, resulting from this condition, are quoted in this book. If the portal vein is obstructed,

there may be thrombosis, and ascites will result, which, if pressure also is exerted upon the common duct, will be associated with jaundice. A diagnosis of malignant disease will then be made, as recorded by McArthur, Barrs, and others. If pressure be made upon the duodenum, the signs and symptoms of pyloric stenosis will be manifest, and an operation for that condition will be undertaken. Examples of this are related by Mikulicz and Maclagan. In one of his cases Mikulicz performed gastro-enterostomy, and only six months later, on performing cholecystotomy, discovered the cause of the duodenal obstruction. In another, a patient aged twenty-nine had suffered for six months from great dilatation of the stomach and excessive wasting. Stenosis of the pylorus from simple ulcer was diagnosed and an operation undertaken. After opening the stomach Mikulicz found, at the base of the pyloric ulcer, a gall-stone "larger than a thumb joint."

Diverticula are also, though less frequently, found in connexion with the common duct. They spring almost invariably from the upper part of the duct and do not necessarily cause any impediment to the onward flow of bile; jaundice, therefore, may be absent.

A case in which a diverticulum had formed from the pancreatic portion of the duct is recorded by Thienhaus (*Annals of Surgery*, vol. 36, p. 927). The description of the operation upon this case is reproduced in the chapter dealing with operations upon the common duct.

In contradistinction to all the foregoing there are changes in the wall of the gall-bladder and of the ducts, especially in the former, which lead, not to thickening,

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but to atrophy of the walls. In some instances the gall-bladder, "as thin as paper," fits closely on to a



FIG. 30.—Shewing dilatation of the gall-bladder and biliary ducts. In the hepatic ducts are several large brown calculi; a small one of the same kind lies in the cystic duct, and several in the common duct, but there are none in the gall-bladder (Royal College of Surgeons' Museum, No. 2825).

number of impacted stones; in others, exemplified in one of my cases of cholecystectomy, there may be a small stone impacted in the cystic duct and the gall-bladder

may contain only a few drams of a thin and watery fluid.

When a great part of the wall of the gall-bladder seems healthy, there may be local thickening and puckering at the site of an old ulcer. These scars are commonly seen in cases of old-standing cholecystitis, and may be single or multiple. If the cholecystitis has been acute, or has been chronic, adhesions on the outer surface of the gall-bladder will almost certainly be seen. When the inflammation is of recent date, the adhesions are thin, filmy, and easily detached; when the disease is of old standing the adhesions are so complex that half an hour may be spent in detaching them before the landmarks can be recognised. The gall-bladder then is often shrunk and may be contracted and withered almost beyond recognition. Such adhesions, the result of a pericholecystitis, may affect all the adjacent structures, the liver, colon, duodenum, and stomach being all gathered up into a mass of the densest complexity.

When ulceration extends deeply into the wall of the gall-bladder the peritonitis which results upon the outer surface may result in the adhesion of the stomach, the duodenum, the colon, or any part of the intestine. If, then, a perforation of the gall-bladder occurs, an opening is made into these hollow viscera and a fistula results.

Changes Seen in the Common Duct.—When gall-stones are for any length of time fixed in the common duct they give rise to a great variety of altered conditions. The absolute fixity of a stone is rare. As has been shewn by Fenger, the stone soon comes to act as a “ball valve.” The duct behind the stone becomes dilated, and within

this larger duct the stone is free to move. The dilatation of the duct is chiefly due to two factors: first, inflammation, softening the duct wall and causing it to yield; and second, the pressure of the bile. The secretion pres-



FIG. 31.—Chronic cholecystitis (calculous disease). The gall-bladder is represented by a mass of tough inflammatory tissue, surrounding a small cavity in which lay a number of small gall-stones. The common bile-duct (laid open) is much dilated. In it lay three large oval stones; two removed during life by operation through the opening seen in its anterior wall, the remaining stone, which blocked the duodenal end of the duct, being found in the wound at the autopsy. The bile-ducts and the liver were greatly dilated, and the liver was deeply jaundiced. From a woman aged sixty. At the operation much difficulty was experienced from matting of the tissues around the bile-ducts in the hilum of the liver (Charing Cross Hospital Museum, No. 1305).

sure of the bile has been shewn by Noel Paton and Balfour to be no more than 24 mm. of mercury; but this low pressure acting constantly upon the wall of a weakened duct is ample to produce a high degree of dilatation.

The distension of the common duct is sometimes remark-



FIG. 32.—Dilatation of the common bile-duct; cholecystotomy; drainage. On the under surface of the liver is a thick-walled cyst about six inches in diameter the interior of which is smooth and presents three openings, communicating respectively with the dilated hepatic and cystic ducts and with the distal portion of the common duct. The last $\frac{3}{4}$ inch of the common duct is of less than normal calibre, and shews a valvular fold so far obstructing its lumen that after death fluid could not be forced from the cyst through the biliary papilla. From a woman aged twenty-one, who for two and one-half years suffered from persistent jaundice the onset of which was not preceded by pain. A tumour in the hepatic region extending to the level of the umbilicus was twice aspirated, three and a half pints being removed on each occasion. Immediately after the second aspiration the gall-bladder was laid open and stitched to the abdominal wall. Death took place two days later. No calculus was found (Guy's Hospital Museum, No. 1419).

able. Terrier records three cases in which the common duct was dilated to such a size that a palpable tumour was observed; in one a diagnosis of pancreatic cyst was made; in another a diagnosis of distended gall-bladder, and in a third a diagnosis of hydatid cyst of the liver. Several instances are recorded where the last mistake has been made. In cases recorded by Swain and Mayo Robson the common duct has been dilated to a degree permitting its anastomosis with the small intestine.

Edgeworth (*Lancet*, 1895, i, 1180) reports the following instance of dilatation of the common duct:

The patient, a girl of four and one-half years, had been quite well until six months of age, when she became jaundiced. This lasted two or three weeks. Since that time she had slight recurrent attacks of jaundice every six months or so. Otherwise she had been well and developed normally. About one year before admission, however, when three and one-half years old, "the child's stomach began to grow big," and this enlargement slowly increased, though none the less the girl appeared to be in good health until about four weeks before, when she became thinner in body and face. On examination, the patient was found to be well grown for her age and moderately well nourished. There was a slightly yellow tint to the conjunctivæ and skin. The urine contained a small amount of bile pigments and no albumin. The stools were bile-stained. The liver was enlarged, the upper limit of dulness extending to the upper border of the fourth rib in the nipple line, and its lower edge in the epigastric notch being lower than normal. The surface of the liver in the latter situation felt smooth and firm. Immediately beneath the abdominal wall, in portions of the epigastric, umbilical, right hypochondriac, and lumbar

regions, an intra-abdominal tumour was found measuring about three inches in transverse and three and one-half inches in longitudinal diameter, with the lower edge one inch below the level of the umbilicus. The tumour was slightly movable laterally, of rounded shape and smooth surface, with an elastic feel like a tightly distended bladder. Fluctuation was doubtful. The tumour was dull on percussion and the dulness was continuous with the liver above. Spleen enlarged; no ascites. It was considered to be a distended gall-bladder. The tumour was incised, twenty-nine ounces of normal bile were evacuated, and a drainage-tube inserted. The child died in one week and at autopsy the gall-bladder was found very small and contained a little inspissated bile. The cystic duct was obliterated, a fibrous cord representing it. The lower end of the common duct was stenosed; its lumen admitted a hair-pin. The middle portion of the common duct was so distended as to form the sac, which had a thick wall consisting of layers of fibrous tissue. The common duct above this and the hepatic duct were somewhat dilated, as were also the biliary ducts. The liver was enlarged and was in a state of biliary cirrhosis. The cause of the condition was not clear, but he thought it due to repeated attacks of catarrh of the ducts.

Barlach (*Deut. med. Woch.*, 1876, No. 31) observed a thick-walled cyst almost as large as a child's head formed by a dilatation of the common duct. The cyst was adherent to the stomach above and communicated with it by a perforation 6 cm. long. The gall-bladder formed an appendage to the upper part of the cyst, with which it communicated by a small opening; the hepatic duct opened into the cyst. The cyst was formed by the upper part of the common duct, the lower part being blocked by "a fleshy tumour."

Frerichs (*Klinik d. Leberkrankheiten*, vol. 2, p. 433) describes a specimen in the museum at Breslau removed

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from a woman who died as a result of obstruction of the common duct. The cystic and upper parts of the duct were dilated to form a cyst eight inches long and five inches wide.

In Guy's Hospital Museum is a specimen (No. 1429) shewing a papilliferous cyst of the common bile-duct, the cyst communicating by several perforations with the first part of the duodenum. The patient was a boy aged four, the right half of whose abdomen was occupied by a fluctuating swelling from which five pints of greenish, purulent fluid were withdrawn. After death, eleven days later, the cyst was found to communicate with the cystic, hepatic, and common bile-ducts and with the fundus of the gall-bladder.

The fluid contained in these dilated ducts is generally bile, for the obstruction is almost always intermittent and of the "ball valve" type. Rarely, however, when the obstruction is impassable, the fluid is clear, as was first shewn by Moxon. The mimicry of a gall-bladder whose outlet is blocked by a stone in the cystic duct is then complete. Complete block of the cystic duct or of the common duct results in the retention behind them of a clear or slightly turbid fluid containing mucus. Behind an incomplete or intermittent block bile is retained.

The interior of the duct may not seldom shew evidence of ulceration, which may lead to the formation, in the last stage, of diverticula or of fistulæ. Fistula between the termination of the common duct and the duodenum is probably a very common condition. Many examples are recorded under the name of "wide-mouthed opening" of the common duct. In Courvoisier's records ulcerative

perforation into the duodenum occurred in six cases, into the general peritoneal cavity in eight cases.

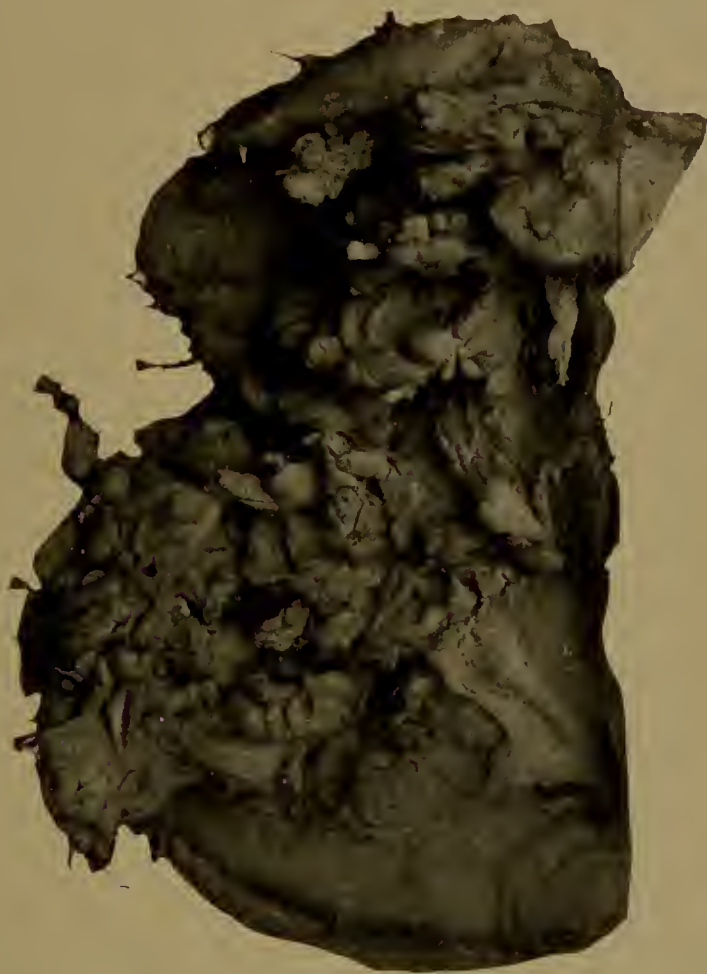


FIG 33.—Papilliferous cyst of the common bile-duct, the cavity of the cyst communicating by several perforations with the first part of the duodenum. The patient, a boy aged four, was admitted for enlargement of the abdomen, emaciation, and vomiting of seven months' duration. The right half of the abdomen was occupied by a fluctuating swelling from which five pints of greenish, purulent fluid were withdrawn. After death, eleven days later, the cyst was found to communicate with the cystic, hepatic, and common bile-ducts and with the fundus of the gall-bladder (Guy's Hospital Museum, No. 1429).

The ulceration in its healing causes a stricture, and the points of narrowing, like the points of ulceration, may be single or may be many.

A pericholangitis, a peritonitis surrounding the common duct at its upper end, may be one of the results of inflammation within the duct, and by its means so great a narrowing of the calibre may be produced that jaundice may be present as an enduring symptom.

Suppurative Cholangitis.—When infection of the gall-bladder and bile-ducts occurs, every stage of inflammation of the mucosa, from the slightest form of catarrh up to the most extensive suppuration, may be witnessed. In the gall-bladder the conditions already described are found. In the common and hepatic ducts, cholangitis, ulceration, perforation with the formation of fistula, and widespread suppuration, extending upwards to the smallest of the ducts within the liver, may be found. The inflammation may at times resemble that found in membranous cholecystitis, and casts of the duct of larger or smaller size may be found. Thudichum, in his work on gall-stones, asserted that the nucleus of many of the stones found in the gall-bladder could be shewn to consist of a cast of the finest hepatic ducts, but his observation has lacked confirmation. When inflammation and obstruction coëxist, the walls of the common and hepatic ducts give way. In chronic cases a marked thickening of the duct, due to a deposit of fibrous tissue, is found. When the duct is incised for the removal of a stone, its walls are seen to be thick, tough, and yellowish white in colour. The duct beyond the calculus, between the stone and the duodenum, is often softened and dilated also so as readily to allow of the passage of the forefinger. When the inflammation is virulent, the suppuration extending into the liver may give rise to the condition which Leonard Rogers

has aptly termed "biliary abscess." There is a general suppurative cholangitis, and the liver has been likened to a sponge whose interstices are filled with pus. By enlarging and causing disintegration of the intervening liver substance a large hepatic abscess may be formed, which may reach the surface of the liver and then burrow upwards into the chest, downwards into the abdomen, or, in the most happy event, reach the surface of the body. The contents of such abscesses are not uncommonly tinged with bile, and when there is a general purulent disintegration of the liver, hepatic cells may be found on examination of the fluid. The offending organisms found in the pus are the bacillus coli, most frequently, and the staphylococcus pyogenes aureus and albus, and various streptococci.

Suppurative cholangitis in the majority of instances is found as a result of occlusion of the common duct by a stone or other foreign body, a hydatid for example, as in two cases under my care. The condition, however, may result from typhoid fever, and the typhoid bacillus alone, or in a mixed infection, is then found in the pus.

Another organism found, either with or without the presence of stones, is the pneumococcus. This has been found alone or in company with the bacillus coli. Domeniei, in experimenting upon animals, injected bacillus coli, typhoid bacilli, and pneumococci into the gall-bladder and into the bile-ducts. When injected into the former the results were always negative; when into the latter, the results were always positive, acute cholangitis resulting. In some instances, when the bacillus of typhoid and the pneumococcus were injected, endocarditis also resulted.

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In several records and in museum specimens the importance of a secondary infection upon an old-standing disease of the common duct is shewn. In cases where there is gall-stone disease in any of its various forms the onset of enteric fever adds a serious risk to the patient's condition, and may be the determining cause in an acute suppuration in any part or in the whole of the bile passages. Hepatic abscesses depending upon cholelithiasis may, as shewn by Naunyn, be formed in several ways:

1. An empyema of the gall-bladder may burst into the liver.
2. Purulent cholangitis of the intrahepatic bile-ducts leads to ulceration of the mucous membrane, and the ulcerative process spreads from the duct walls to the neighbouring parenchyma of the liver. The bile-ducts, around which the suppuration occurs, are often filled with inspissated pus, or, more frequently still, with dark-coloured pultaceous deposits of bilirubin calcium.
3. Necrosis of the liver cells at the periphery of the lobule, suppuration, and the casting off of the necrosed tissue; the process of "hepatitis sequestrans."
4. Hepatic abscess occurring with cholelithiasis may be embolic.

Pylephlebitis may be set up by the pressure of a stone in the common or cystic ducts, causing thrombosis in the disorganization.

The suppurative process extending from the liver may give rise to a subphrenic abscess, to pleurisy, or to empyema. In one case, related by Simmons (*Amer. Journ. Med. Sci.*, Oct., 1877, p. 463), an abscess burrowed upwards into the anterior mediastinum, and finally burst into the

right bronchus. Two cases are recorded by Vissering and Colvée, in which gall-stones have been coughed up with pus and bile.

Biliary abscess of the liver, general suppurative cholangitis, is due in the majority of instances to gall-stone obstruction in the common or hepatic ducts. Leonard Rogers found gall-stones in eighteen out of twenty cases whose records he studied. In the seventy-four cases collected by Courvoisier gall-stones were the cause, directly or indirectly, in fifty-seven.

Membranous cholecystitis and cholangitis are rare sequelæ of gall-stone irritation. But few cases of this disease are recorded; in some, gall-stones were present; in some, gall-stones had been passed, but could not be found at the autopsy; and in others no gall-stones were at any time perceptible. The following case is recorded by Fenwick (Brit. Med. Journ., vol. 1, 1898, p. 1072):

The patient, a male, aged twenty-nine, had nine attacks of biliary colic in the last fourteen months, accompanied by more or less severe jaundice. During the first two attacks he passed on each occasion a fairly large faceted gall-stone. The fæces had not been examined during the later illnesses, but from his severe pain and symptoms, exactly resembling his earlier attacks, he feels sure that he has passed a stone on each occasion. Fourteen days ago he had a severe colic, necessitating the use of morphine, and next day passed a large "piece of flesh," which was examined by his doctor, who described it as an oblong sac, with moderately thick walls, stained green, about two inches long and one inch broad, resembling the gall-bladder in shape. Ten days later he was again seized with severe pain, similar to that experienced in all the

former illnesses, and after some hours of agony he was relieved and next day passed another cast which I examined. It is two inches long, one and one-half inches in breadth, its walls are one-tenth of an inch thick, it is a closed sac with a distinct neck, and is stained bright green in parts, especially towards the neck. When laid out, it appears to resemble a gall-bladder. The accompanying fæces were clay-colored, and had been so for a long period of time. There was no microscopic appearance of hydatid structure, and I do not think that it was an intestinal cast. We came to the conclusion that both these casts were derived from the gall-bladder, as the patient had suffered from typical biliary colic many times before the passage of the casts exactly similar to that he had felt before he passed the gall-stones.

It does not seem improbable that the presence of the stones has set up a chronic inflammation in the bladder, which has resulted in the formation of a false membrane, which has itself been expelled after the last stone had been passed.

In one case, related by Malmsten, the gall-bladder of a patient who had died of general peritonitis was found to contain a croupous exudation.

Rolleston (*Path. Soc. Trans.*, vol. 53, p. 405) records a case in which a fibrinous cast of the gall-bladder was associated with a gall-stone. The following is his account:

The patient, a woman, aged fifty-two, who had never had jaundice or biliary colic previously, was suddenly seized with pain on the right side of the abdomen and vomiting. On admission to St. George's Hospital two weeks later a tumour of stony hardness was found in the right iliac fossa, separated from the liver dulness by a zone of resonance. Laparotomy was performed by Mr. Alling-

ham, and revealed a greatly enlarged gall-bladder, united by adhesions to adjacent parts. On opening the gall-bladder a single calculus, rather larger than a walnut, enclosed in a membranous sac, was removed. This membrane was easily detached from the walls of the gall-bladder and was brown in colour and not unlike a dysmenorrhœal cast of the uterus. Its walls were from a quarter to one-sixth of an inch thick, varying in different parts.

Microscopically, the walls of the cast were composed of fibrin enclosing bile pigment and hexagonal and quadrilateral crystals. The crystals were soluble, without effervescence in dilute nitric acid, but not in acetic acid. On the outer layer of the cast there were a number of small round cells, and scattered through the fibrinous network there were a few nuclei. There was no trace of the mucous membrane of the gall-bladder in this membranous cast. No micro-organisms could be seen in specially stained specimens.

In the present case the fibrinous structure of the membrane is quite different from the histological appearance of the intestinal casts of mucous colitis, and the process cannot be considered to be comparable to that of mucous colitis. Its structure suggests a comparison to acute membranous inflammations of mucous surfaces, such as have been found to be due to pneumococcal infection, but pneumococci were not found in this case.

The association of attacks of a nature precisely similar to that in which a gall-stone is passed, with the passage of membranous casts in the fæces, was first observed by Richard Powell: "On Certain Painful Affections of the Intestinal Canal" (Medical Transactions of the R. C. P., vol. 6, p. 106, 1820). These casts were due to the disease now regarded as "membranous colitis." There is noth-

ing in Dr. Powell's account to suggest that any part of the casts came from the gall-bladder or bile-ducts. The association of cholelithiasis with membranous colitis has since been observed by Mayo Robson, myself, and others.

The following case of membranous cholecystitis was under my care:

History.—Mrs. A., aged forty-three. Seen August 21, 1902, with Dr. Carlton Oldfield. The patient had suffered all her life "from spasms." Pain was felt in the right hypochondrium, shooting thence through to the back and all over the abdomen; it was attended by vomiting and collapse. There has never been any jaundice. Seven weeks ago a tumour was noticed on the right side of the abdomen, a little above and internal to the anterior superior spine. Constipation has latterly been a marked feature, and distinct intermittent intestinal coiling has been seen, the cæcum rising up very prominently and loud borborygmi have been heard. On several occasions an abundance of thick, blood-stained mucus or unstained mucus has been passed in the motions. The tumour is densely hard, irregular in outline, very slightly movable laterally and vertically during respiration; it is not tender to the touch. A diagnosis of growth of the ascending colon was made and laparotomy advised.

Operation.—The abdomen was opened on August 28th. A hard tumour, adherent to the abdominal wall and ascending colon, was found. On first examination it was thought that the diagnosis was accurate, but a gradual separation of adhesions revealed the gall-bladder lying buried in a trough made by the colon and adherent by strong bands to the colon and abdominal wall. The cæcum was large and very much hypertrophied, feeling tough and leathery. There was very dense thickening and stiffening of the ascending colon at the part where lay the distended

gall-bladder. The much-thickened gall-bladder was laid open and 368 stones were removed. The gall-bladder was then seen to be lined with a thick, membranous coating, which peeled off the mucous membrane very readily. The condition was one of membranous cholecystitis. The gall-bladder was therefore removed with a portion of the cystic duct, and the abdominal wound closed without drainage. The patient made a perfect recovery and is now in good health, doing her ordinary household duties.

Stricture of Ducts.—The ulceration caused by gall-stones in the hepatic or common ducts may, in the healing which ensues upon the passage of the stone, give rise to a *stricture* of the duct. Hoffmann (Virch. Archiv, Bd. 39, p. 206) found a stricture which involved the common hepatic duct for 1 cm., the left hepatic duct for 1.4 cm., and the right for 0.8 cm. The finest bristle could not be passed through it; the walls of the stricture were thick and cicatricial. Merbach (Schmidt's Jahrb., 141, p. 107) records a somewhat similar example. Moxon found a stricture of the hepatic duct in a man of thirty-one years of age who had suffered from cholelithiasis. It was situated about one inch above the point of junction with the cystic duct. The walls were irregularly thickened and fibrous. No gall-stone was found in the duct, nor any ulceration. Bristowe (Path. Soc. Trans., vol. 9) and Holmes (vol. 10) relate cases of stricture of the hepatic duct. The latter calls attention to the resemblance of the appearances to those found in stricture of the urethra.

Stenosis of the common duct may be produced in a similar manner, or the duct may be compressed, twisted, kinked, or otherwise warped by the action of adhesions

which surround it. Cases in which a stricture of the common duct, dependent on gall-stone ulceration, has been excised, are recorded by Kehr and Mayo.

Hæmorrhage.—Hæmorrhage from the gall-bladder and bile-ducts, as the result of calculous disease, is sometimes seen, and may be a symptom of dire significance. In old-standing jaundice a tendency to hæmorrhage is one of the most remarkable clinical features. Operations upon these patients is attended by the risk of continued bleeding, which may end fatally. This tendency is decidedly more frequently present when the jaundice is dependent upon pancreatic disease, as was first shewn by Mayo Robson. The hæmorrhage from the vessels of the abdominal wall may, in such circumstances, be so profuse and so long-continued as to be the immediate cause of death. In patients so affected there may be large hæmorrhages into the sub-peritoneal tissue, or, indeed, into any part of the body, as the result of the most trivial injury. When pressure is exerted by a stone, in the cystic or common ducts, upon the portal vein, there may be submucous hæmorrhages in any part of the intestinal canal, and the bleeding from the congested surface into the bowel may be profuse. A case is related by Naunyn of a woman, aged fifty, who had suffered from jaundice for six months; ascites developed rapidly, and about three weeks later there was a profuse hæmatemesis, with melæna, and coma developed. At the autopsy a stone in the cystic duct was found to be pressing upon the portal vein, which contained a clot. The mucous membrane of the intestine and of the stomach exhibited hæmorrhagic areas but was nowhere ulcerated.

Quinquaud—quoted by Hoppe-Seyler and Schüppel—



FIG. 34.—Shewing the gall-bladder and bile-duets distended by blood: Cholecystotomy. There was a laceration two and one-half inches long in the anterior wall of the gall-bladder. The cystic duct and lower part of the common bile-duct are slightly dilated, the remainder of the latter and the hepatic ducts enormously so. Below are seen the clots removed from the gall-bladder (measuring two and one-half inches transversely) and the hepatic duct (one and one-quarter inches). From a woman, aged fifty-four, who, while suffering from jaundice of two months' duration, was suddenly seized with acute abdominal pain and collapse, together with a rapidly increasing tumour of the gall-bladder. Much blood was passed per rectum. Laparotomy was performed five days after the onset of the acute symptoms and almost a pint of blood-clot was removed from the gall-bladder. Death took place a few hours later (Guy's Hospital Museum, No. 1389).

described a case of hæmorrhagic cholangitis in which so large a quantity of blood was poured into the bile-ducts and into the intestine that death followed from hæmorrhage.

The following case is recorded by W. Arbuthnot Lane (Clin. Soc. Trans., vol. 28, p. 160):

The patient, a female, aged fifty-four, was admitted to St. John's Hospital, Lewisham, on December 20, 1894. Two months previously she had developed jaundice, which became very deep. There was no history of a previous attack or of any pain or discomfort in the region of the gall-bladder. The liver was enlarged and she had pain about the gall-bladder. On December 16, owing to the taking of a strong purgative, she was seized with profuse diarrhœa, with severe straining. During a severe bearing-down effort she suddenly exclaimed that she had felt a very sharp pain in the region of the gall-bladder, as if something had given way. A surgeon was sent for, who found a rounded tumour in the position of the gall-bladder. The diarrhœa continued in a lesser degree and the motions consisted chiefly of blood. Next day the tumour was larger, but the pain was not so intense. On December 21 she was much worse, and the temperature rose to 100°. Mr. Lane was called in consultation. He decided on operation and exposed the gall-bladder by an incision over it. The tumour protruded at once through the wound, when it was found to be firm and inelastic, like a soft growth. It was incised and three-quarters of a pint of blood-clot turned out. The cystic, hepatic, and common ducts were also enormously distended with clot. No stone could be felt. The patient died the same night.

Postmortem.—The gall-bladder was distended to about twice its normal size and was filled with clotted blood. The common duct was greatly distended and was com-

pletely filled with firm blood-clot, which extended into the main hepatic duct and into the branches of the ducts within the liver.

The mucous membrane of the gall-bladder was lacerated for a distance of about one inch and a half in the anterior wall, and the rent extended for a small distance into the substance of the liver. In the absence of any other discovered cause, it appears probable that this laceration of the mucosa was the source of the hæmorrhage. No gall-bladder stone was found nor any other cause for the jaundice than the obstruction of the ducts by the blood-clot.

It is possible that the stone which produced the obstructive jaundice was forced into the bowel by the pressure of the blood behind it, and that it escaped unobserved in the evacuations which were thrown away by the friends. (Guy's Hospital Museum, Specimen, No. 1389.)

Many cases are recorded of hæmorrhage from the stomach or from the bowels during the formation of fistulæ between the gall-bladder and the alimentary canal. Fatal hæmorrhage from the biliary passages as the result of cholelithiasis is recorded by several writers, Naunyn, Chiari, and others. In some of these false aneurysms of the hepatic or of the cystic arteries have been found to have ruptured. The following case is recorded by Cahn and quoted by Naunyn:

An elderly woman had long suffered from epigastric pain and vomiting after food. The diagnosis lay between round ulcer of the stomach or duodenum and cholelithiasis. No gall-stones could ever be found in the stools. Five weeks before her death there occurred a copious gastric and intestinal hæmorrhage, and a few days later a more severe one, with the passage of bright red blood from the bowel.

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Then followed slight jaundice, without discolouration of the stools, and this repeatedly recurred in a transitory manner. A similar hæmorrhage occurred three weeks before death, and finally a rapidly fatal intestinal hæmorrhage. At the postmortem there was found a false aneurysm of the right hepatic artery "which lay in contact with that part of the hepatic duct which was over against the point of a gall-stone which had penetrated into it from the cystic duct." This aneurysm had ruptured into the hepatic duct. There were, in addition, three perforations from the gall-bladder into the duodenum.

Many fatal cases of hæmorrhage into the gall-bladder and ducts after operation are recorded by Riedel, Quénu, and others.

Schwartz relates (Bull. et Mem. Soc. de Chir., vol. 29, p. 677) the case of a man of forty-three who was operated upon in April, 1901, for cholelithiasis. The gall-bladder contained a litre of bile. The common duct was explored with a negative result. The head of the pancreas was found increased in size and indurated. Cholecystotomy was performed. A biliary fistula persisted until January, 1903, when he became jaundiced and died from profuse and incoercible hæmorrhage from the fistula.

Malignant Disease.—One of the most serious of the sequelæ of cholelithiasis is malignant disease of the gall-bladder or of the ducts. The close connexion between gall-stones and malignant disease has never lacked recognition, though opinions have differed as to which is the cause and which the effect. Opinion is now universally in favour of the view that it is the irritation of the gall-stones

that determines the incidence of cancer, the view that was first supported by Klebs. In his record of cases Courvoisier found the following results:

Of 84 cases of primary cancer of the gall-bladder, there were 72 in which stone were found; in two others stone had been passed in the motions. In the remaining 10 no mention of stones is made; in four of these there were certain pathological changes: scarring of the duodenal papilla, stricture thereof, and dilatation of all the bile passages, which indicated, unquestionably, the former presence of calculi.

Janowski quotes Brodowski as having examined 40 cases of primary cancer and finding gall-stones in all.

Siegert (Virchow's Archiv, Bd. 132, H. 2, 1893) investigated cases both of primary and of secondary cancer. In primary cancer gall-stones are present in 15 per cent.

Musser, writing in 1889, had collected the notes of 100 cases of primary cancer of the gall-bladder, verified



FIG. 35.—Papillomata of gall-bladder. From a woman aged fifty-nine who died from phthisis. Two large faceted calculi and some fragments of a third were found in the gall-bladder (Guy's Hospital Museum, No. 1404).



FIG. 36.—Primary columnar-celled cancer of the bile-duets. The common bile-duct shews, at its junction with the cystic duct, a tight cancerous stricture which involves also the latter. The bile-duets above are extremely dilated and the liver deeply jaundiced. The gall-bladder presents a deep-red inflammatory appearance (following on operation). From a woman, aged forty-five, who experienced severe epigastric pain, jaundice, and vomiting about two months before admission. A lump had been noticed in the abdomen for five weeks and the lower edge of the enlarged liver reached nearly to the umbilicus. The liver surface was irregular, but presented no nodules. The gall-bladder was opened and thirty-two stones were removed, some embedded in solid material connected with the wall; seven more were extracted from a pouch at the exit of the cystic duct. A hard lump was felt in the common duct, and a second similar lump in the cystic duct. The opening in the gall-bladder was sewn to the parietal peritoneum and a tube inserted. After operation there were progressive weakness, increasing jaundice, and slight but persistent pyrexia (Charing Cross Hospital Museum, No. 1332).

postmortem. Gall-stones were present in 69. Jayle, in 30 cases collected entirely from French records, found that stones were present in 23 cases.

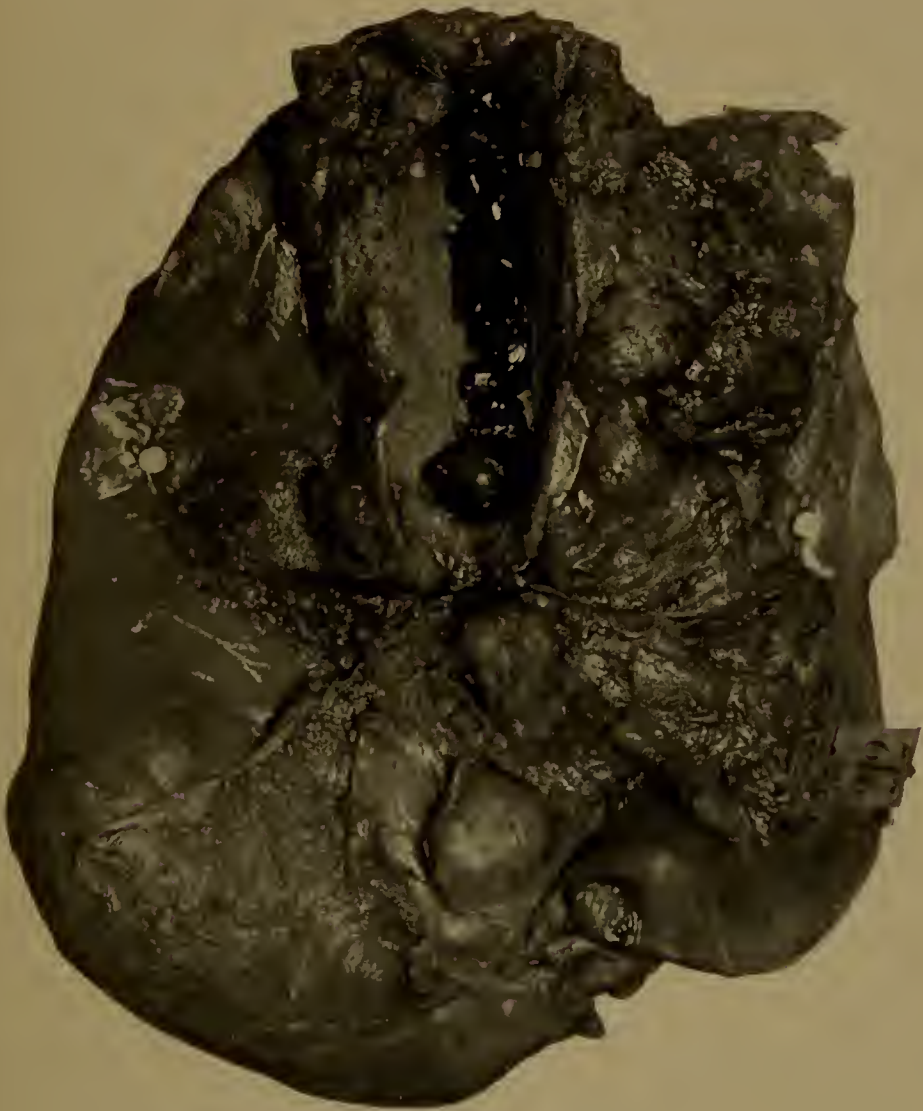


FIG. 37.—Carcinoma of gall-bladder, with gall-stones. Secondary deposits in the liver (London Hospital Museum, No. 212).

Primary carcinoma of the bile-ducts is far less commonly seen than in cancer of the gall-bladder, and the association between gall-stones and growth is not so clearly shewn in

postmortem records. A specimen of primary columnar-celled carcinoma of the bile-ducts due to gall-stone irritation is in the Museum of Charing Cross Hospital (No. 1332). Rolleston, writing in 1896, found that stones were present in only four cases out of 11. He considers that calculi are less commonly associated with cancer of the bile-duct than with cancer of the gall-bladder, but he admits the possibility of the passage of gall-stones after the development of the growth and before the death of the patient. Courvoisier gives two cases of cancer of the common duct due to the irritation of stones.

Ingelrans found that in cancer of the hepatic duct the association with gall-stones was unusual.

In some of the museum examples the implantation of the malignant change upon a chronic ulcer of the gall-bladder is well seen. The condition is exactly similar to that of "ulcus carcinomatosum" seen in chronic ulcer of the stomach.

An examination into the records of a number of cases of cancer due to gall-stones shews that in many, certainly in a majority, jaundice had never been present. The symptom most commonly recorded is cramp in the stomach, followed by sickness and vomiting. The symptoms, that is to say, are in the greater number of cases those due to stone contained within the gall-bladder. Though gall-stones are present and are the cause of the malignant disease, they may never have been suspected.

In very rare instances malignant disease of the gall-bladder may occur after cholecystotomy. The following case was under the care of my colleague, Mr. Lawford Knaggs, to whom I am greatly indebted for the notes:

Sarah D., aged sixty-nine, a spare old woman, who looked and expressed herself as being very healthy, was admitted on September 8, 1902. She had never had any trouble with her digestion or her bowels except some slight diarrhoea two years before. Seven weeks before admission she felt pain in the right hypochondrium which wore her down when she walked. The pain gradually mounted higher till it was felt over the lower ribs, and her doctor discovered a tumour in the right loin.

She had never been jaundiced or had any attack of severe abdominal pain and she had lost no flesh. She had a goitre of long duration which caused no trouble.

On examination, a smooth, rounded swelling was found in the right loin. It was evidently attached to the liver and was regarded as a distended gall-bladder, which, from its mobility, was free from adhesions. A tender spot was always to be found on pressure at a point midway between the umbilicus and the tip of the ninth rib, and a gall-stone impacted in the cystic duct was diagnosed.

The urine was normal.

On September 11 the patient was anæsthetised and an incision was made over the gall-bladder. This, much elongated and distended to the size of a fist, was drawn out of the wound and a quantity of foul-smelling fluid with some pus was drawn off by the aspirator. A single stone was felt in the cystic duct and was squeezed back into the gall-bladder and removed. It was about the size of a nutmeg, oval, and not faceted.

The gall-bladder was very long and supple, not noticeably thickened, and no suspicion of anything abnormal was raised by the examination of the cystic and common ducts which was made in the routine manner. An india-rubber tube was now fixed in the gall-bladder, which was then attached to the aponcurosis, but, owing to its length, a portion of the gall-bladder wall was allowed to lie above the opening and between the lips of the skin incision. From

this circumstance the fistulous opening refused to close, but the amount of bile that came from it steadily diminished and became so trivial that it proved to be no discomfort to the patient. Consequently, no thought of doing anything to close it was entertained. The following report of the fluid removed from the gall-bladder was made by J. A. C. Forsyth, M. B.:

"On agar there was an active growth in five hours. At the end of three days culture examined. Foul odour noticed on withdrawing plug from tube. Film preparations show bacillus coli communis in pure culture."

The patient left the hospital on October 19, 1902. She was seen from time to time as an out-patient and, except for the fistulous opening discharging a very little bile, she was quite well.

About the end of 1903 she came complaining of pain in the right hypochondrium. She stated that the fistula had closed and that the pain began as soon as it ceased to discharge. Some thickening under the skin around the cicatrix of the fistula was to be felt, but this was attributed to the redundant portion of the gall-bladder which had been allowed to remain in the wound above the aponeurosis. For two or three weeks she continued to attend as an out-patient, but the pain then became so continuous and so distressing that she was very glad to consent to the fistula being reestablished. During this time she lost flesh and was readmitted on January 23, 1904. The urine was normal. On the 26th she was anæsthetized and a small incision was made into the gall-bladder over the closed sinus, and the mucous membrane was sutured to the skin. A considerable quantity of mucus with some purulent dregs escaped, but no stone could be felt with a probe. The intense pain was relieved by the operation, but the patient did not seem to recover her spirits. On January 28 she had a rigor and the temperature rose to 105° . She had another rigor on the 29th (temperature 102°).

and on February 4 the temperature rose to 103° and gradually fell; but with these exceptions the temperature kept about the normal throughout. The pulse varied from 72 to 100, but it averaged from 80 to 90. Two or three days after the first rigor jaundice was first noticed and marked tenderness on pressure was present in the middle line above the umbilicus. The jaundice increased and was evidently due to obstruction. The left lobe of the liver enlarged and reached almost to the umbilicus, and all over it was very tender. There was also much pain in the right hypochondrium and around the right lower ribs. The mucus coming from the gall-bladder became bile-stained.

The patient complained of feeling very ill, was listless, and often drowsy. Albumin appeared in the urine and there was œdema of the legs and abdominal wall. Gradually she passed into a semi-conscious state. Petechial vesicles appeared over the body and she died on February 17, 1904.

Mr. Gruner, the pathologist, examined the blood on February 8, and reported as follows:

"Red cells, 480,000 per c.mm. White cells, 10,000 per c.mm. The neutrophile leucocytes predominated. This result is quite in accordance with the blood-find in cases of malignant disease."

Necropsy.—*Abdomen.*—The liver was somewhat enlarged. On laying open the gall-bladder through the fistulous opening it was found to be the seat of malignant disease. The walls of the gall-bladder were infiltrated with growth to the thickness of nearly one-half inch, and the growth extended to and involved the cystic duct, practically occluding it. No growth involved the common hepatic or the common bile-ducts, but the growth involving the cystic duct had pressed upon and partially obstructed the commencement of the common duct. Above this stricture the ducts were markedly dilated and were the seat of suppurative cholangitis.

The surface of the liver showed numerous cystic elevations due to the dilated terminal ducts, and on section the dilated bile-ducts were found filled with pus. A small secondary nodule of growth was present in the left lobe near its anterior margin. No gall-stones were found. The pancreas was normal. The kidneys were small and slightly granular—other organs normal.

Chest.—There were some adhesions in both pleural cavities and both lungs were the seat of chronic bronchitis.

A microscopic examination of the growth of the gall-bladder showed it to be a columnar carcinoma.

Changes in the Liver.—In cases of obstruction of the common or hepatic ducts the liver, when examined during life, is found in the early stages to have undergone a considerable enlargement, reaching perhaps down to the umbilicus; in the later stages the liver gradually shrinks and eventually may become very much smaller than the normal. The condition of enlargement of the liver or hypertrophy, as it is often called, may persist for many months. During each successive attack of inflammation in the ducts, as shewn by an elevation of temperature and rigor, and an increase in the depth of the jaundice, a slight further increase in the size of the liver is commonly observed, and palpation shews that the liver is also tender upon pressure. If a liver be examined in this stage, after death, it is seen that the hepatic ducts have undergone a considerable dilatation, so that a series of cysts, as it were, are formed in the liver. The outer surface of the liver may also be irregularly raised, the dilated ducts forming smooth, spherical protuberances upon its surface. These cysts contain bile almost always; in some cases fine

calculi; or a biliary sand, or mud, consisting chiefly of bilirubin calcium, may be found therein. In cases of complete obstruction of the common duct, supervening upon an incomplete obstruction, the fluid may consist of mucus alone, or of mucus faintly tinged with bile. In the worst examples the absence of bile, acholia, may be due to a profound alteration in the hepatic cells.

In the condition of atrophy of the liver a section of the organ shews the same dilatation of the hepatic ducts, but the liver tissue is in greater or less measure replaced by fibrous tissue. The histological changes in all cases consists of a biliary cirrhosis on the dilatation of the hepatic ducts. Many of the bile channels may at the last be so thoroughly strangled by the abundant deposit of fibrous tissue that they lose their epithelium and finally disappear altogether. The vessels of the liver similarly undergo constriction, and the hepatic cells are in parts strangled out of existence.

If these conditions are associated with a virulent infection, the condition of biliary abscess already described will result.

Riedel's Lobe.—One remarkable change, which though commonly is not invariably associated with the presence in the gall-bladder of a number of calculi, is the formation of a tongue-shaped process which projects downwards from the right lobe of the liver. This process may have many forms and may take its origin from the margin of the liver to the right or to the left of the gall-bladder. It was first described by Cruveilhier, and in the instance given by him the gall-bladder contained many stones. It is to Riedel that we are indebted for

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the fullest and most accurate description of this "linguiform process," as he termed it. He describes (Berlin. klin. Woch., 1888, Nos. 29 and 30) and figures eight forms of the process, and emphasises its dependence upon gall-stone disease. He expresses the opinion that the gall-bladder in its enlargement gradually drags downwards this tongue-shaped lobe of the liver. In recognition of his work the process is generally described as "*Riedel's lobe*." Riedel, Terrier, and other observers have asserted that after cholecystotomy the projecting lobe gradually shrinks, and the liver then assumes its normal outline. In a very thin woman, upon whom I performed cholecystectomy, a lobe, at least three inches in length, has almost disappeared in the course of eighteen months. The lobe may be long or short, its pedicle may be thick or thin, it may overlie the gall-bladder or be placed to its inner or outer side. As a rule, the liver substance in the lobe is greatly altered from the normal, being paler in colour and more fibrous in texture. The tumour is often recognisable, clinically, as a smooth, solid, elastic tumour, sometimes very freely movable ("floating lobe"), sometimes fixed by adhesion. It has been mistaken for a distended gall-bladder, a movable kidney, a hydatid cyst of the liver, a tumour of the omentum, or an abscess.

I have, on one or two occasions, seen a well-marked Riedel's lobe when operating upon other abdominal conditions, in the absence of gall-stones.

CHAPTER IV.

THE SYMPTOMS AND SIGNS OF GALL-STONE DISEASE.

Gall-stones are present in approximately 10 per cent. of all bodies examined on the postmortem table. The exact percentages given by various writers are as follows:

Riedel	10	per cent.
Kehr.....	10	"
Brewer.....	12	"
Recklinghausen	12.2	"
Reports of the Johns Hopkins Hospital (Mosher)	6.94	"
Herter (Presbyterian Hospital, New York)...	7.6	"

And Naunyn writes: "On an average every tenth human being, and of elderly women, perhaps every fourth, has gall-stones." Djakanow, on the other hand, states that gall-stones are very rare in Russia. In the very great majority of these cases the stones have never given rise to symptoms of sufficient severity to have caused them to be recognised during life. In probably nine persons out of ten who carry gall-stones the disease is never recognised. Gall-stones have been passed, being found in the fæces when no symptoms of their presence have been elicited within a recent period. In such cases, probably without exception, there have been previous attacks of gall-stone trouble, and a fistula has formed

between the biliary passages and the bowel. It is through the fistula and not along the ducts that the stones have passed. In one patient, a woman of seventy, I saw several stones almost unaltered in appearance in the fæces. They were passed without any warning symptoms of gall-stone colic, or pain, or temperature, or jaundice, though all these symptoms had been present over thirty years earlier. About four years after I saw her she died from other causes, and a fistula between the gall-bladder and colon was found.

This point, as to the infrequency of the recognition of gall-stones, requires emphasis, for it shews clearly enough that if gall-stones can be brought to lie quietly in the gall-bladder, there may be a complete immunity from all suffering. There is need, however, for some qualification in the statement so tersely made, for, in the first place, it is an undoubted fact that the commonest manifestation of the presence of gall-stones is never referred by the patient, and rarely by the medical man, to the gall-bladder or bile-ducts. The most cursory examination into the history of a long series of cases treated by operation will show that, in almost all, the earliest symptom, that which has for years caused intense suffering at times, is "indigestion." The variety of names given to the symptoms of epigastric pain, nausea, and vomiting is infinite: "indigestion," "gastric catarrh," "neuralgia of the stomach," "spasms," "flatulent distension of the stomach," are a few of those most frequently encountered. They all, as can be seen, refer the trouble to the stomach, and not to the liver. It requires the unmistakable evidence of jaundice to

associate the suffering with gall-stones in the minds of all patients, and of not a few medical men, yet jaundice is an infrequent and an inconstant symptom of gall-stone disease.

In the second place, it must not be assumed that, though no momentous symptoms of gall-stone irritation are present, all is yet well with the patient. In cases which come to operation, where the most obvious undoubted symptoms have been present for only a few weeks, there will often, one dare venture to say always, be found abundant evidence of chronic inflammatory processes that have taken years in the accomplishing, or of malignant disease that is but the expression of long-persisting local irritation. It is not accurate, therefore, to say that gall-stones, in the vast majority of cases, cause no symptoms. They cause symptoms in a great many cases where the true nature of the disease is never recognised; and gall-stones found at an autopsy upon a patient who has suffered for years from gastric disorders may explain all the symptoms. This fact, of the want of recognition of gall-stone disease, in its earliest stages, must be insisted upon, for it is in this stage that surgical treatment should, if possible, be advised.

The symptoms and signs of gall-stone disease that require discussion are pain and colic, nausea and vomiting, jaundice, fever, and tumour.

1. **Pain** (to be distinguished from colic, of which later mention will be made) elicited by the presence of gall-stones is either *local* or *referred*. *Localised pain* is of two types: a dull aching pain, due to increased ten-

sion and inflammation, limited to the gall-bladder; and an acute, almost intolerable, pain which results from more intense infection and a more widespread inflammation. The dull, localised pain is generally due to a slight degree of irritation and inflammation, with a gradually increasing tension in the gall-bladder or cystic ducts, due to the impaction of a stone in its attempt to pass out of the gall-bladder. The pain is diffused over a large area along and below the margin of the liver. Tenderness is not specially marked; the area can be examined by gentle pressure of the open hand without hurting the patient. If, however, a sudden pressure be made, there is an instant tightening of the muscles, which, by their contraction and rigidity, protect the underlying parts from injury. The best method of eliciting tenderness in such conditions is that which is mentioned by Naunyn and emphasised by Dr. T. B. Murphy, of Chicago, who writes (*Med. News*, vol. 1, 1903, p. 825): "The most characteristic and constant sign of gall-bladder hypersensitiveness is the inability of the patient to take a full inspiration when the physician's fingers are hooked up deep beneath the right costal arch below the hepatic margin. The diaphragm forces the liver down until the sensitive gall-bladder reaches the examining fingers, when the inspiration suddenly ceases as though it had been shut off. I have never found this sign absent in a case of calculus or in infectious cases of gall-bladder or duct disease."

Naunyn writes (p. 79): "If the liver is swollen as the result of the attack (that is, recently), the organ is always more or less tender, and often very acutely so; but

frequently it is tender without being swollen. In such cases it is found that pain is induced when, during a deep inspiration, pressure is made with the hand as far upwards as possible beneath the right costal border. At the moment when the liver impinges upon the tips



FIG. 38.—Method of examination to elicit tenderness of gall-bladder.

of the fingers the patient experiences a deep-seated pain which sometimes radiates over the entire hepatic region and on to the epigastrium."

By no means rarely, however, the tenderness of the liver is only manifested by tension of the muscles of the anterior abdominal wall on the right side, and in such

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cases the difference in tension of the right and left side is best observed in the upper part of the rectus. I have found the simplest method of eliciting the pressure signs to be this: While the surgeon sits on the edge of the couch, to the right of the patient, the left hand is laid over the lower part of the right side of the patient's chest, so that the thumb lies along the rib-margin; as a deep breath is taken the thumb is pressed upwards towards the under surface of the liver. Figure 38 shews the position.

This variety of pain is apt to be confounded with that due to diseases of the stomach. It is a dull, rather diffuse aching, which is often worse after food, and is almost without exception relieved by vomiting. The pain is due to the impaction of a stone and the gradual increase in tension within the gall-bladder. As soon as the stone falls back into the gall-bladder, as it often does after the act of vomiting, the pain is relieved. It is readily understood, therefore, that the act of emptying the stomach is supposed to have given relief to that organ. The pain, however, is sometimes more acute than that described, and is the expression of a higher degree of irritation and of consecutive inflammation in the gall-bladder and ducts, and perhaps also of the peritoneum surrounding them. The pain, whether mild or grave, is certainly due to inflammatory action, and probably indicates that the peritoneum is involved. When the irritation caused by the stone is slight, when its impaction is but of brief duration, the inflammation which is set up is trivial and evanescent; when impaction is more prolonged, a cholecystitis or a cholangitis is not long delayed, and the pain becomes,

therefore, more acute, and the peritoneal investment of the bladder and ducts becomes more widely implicated. That inflammation is the cause of the pain, and that the inflammation is the result of an infection due to the irritation of a stone, there can be no doubt. When the dull, aching, constant pain has been present for years and the gall-bladder be examined, its walls are found thickened, toughened, and fibrous; there may be little or no evidence of surrounding peritonitis. When, however, the pain has been more severe, and especially when there has been a marked rigidity of the muscles overlying the gall-bladder, evidence of peritonitis in the form of adhesions, more or less complex, will be found. The dull, aching pain, elicited by thumb pressure, and the acute, more wide-spread pain, with muscular rigidity, are, therefore, both due to an infection and inflammation. In the former the inflammation is limited to the gall-bladder, producing gross degeneration of its coats; in the latter the inflammation spreads to the surrounding peritoneum and causes the outpouring of lymph, and, at the last, a complex entanglement of the gall-bladder and its surroundings in dense and tough adhesions. The localised pain of cholelithiasis is almost always made easier by steady, even pressure; the radiating pains are unaffected.

The *referred pain* is almost always, though not invariably, associated with one or the other of the foregoing. The pain radiates to the right subscapula region, rarely to the left; to the neck, or down the arm, and to the epigastric region. According to Murphy, in obstructions to the pelvis of the gall-bladder or to the cystic duct, the pain is referred, on an average, in seven cases out of ten,

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to the right subscapular region; in one case, to the left subscapular region; and in two cases out of ten, to the front of the chest as high as the neck. This computation is based upon repeated soundings and irritations after cholecystotomy.

The existence of an area of referred tenderness in gall-stone disease is described by Boas. He finds that in a majority of patients suffering from cholelithiasis there is an area of increased tenderness, on pressure, on the right side behind, on a level with the twelfth thoracic vertebra, two or three fingersbreadth from the spine. At a corresponding point on the left side no tenderness is found. This symptom may be present even when there is no tenderness over the gall-bladder or beneath the margin of the liver.

Boas writes (*Munch. med. Woch.*, April 15, p. 604):

“Least recognised as a symptom of cholelithiasis is tenderness over the posterior surface of the liver. When well marked it extends laterally from about an inch external to the spines of the vertebræ to the posterior axillary line, and vertically from the eleventh dorsal to the first lumbar spines. To demonstrate it the finger should be pressed against a point to the right side of the tenth dorsal spine; then against successive points in lines running horizontally outwards, opposite the other spinous processes, down to the first lumbar spine, first on one side, then on the other. It is then evident which side is the more tender. This symptom, if present during the acute attack, is also invariably present in the intervals; that is, if once present, it is always present, and is therefore of special diagnostic value in the latent stages. Occasionally it may be found years after the last attack of colic.” Con-

versely, if absent in the acute attack, it is not found in the intervals. It is usually sufficient to map out the areas of tenderness with the finger; but when there is a doubt as to whether the right side is the more tender, greater accuracy may be obtained with the faradic or galvanic current. When, as often occurs, the lower edges of the liver and the gall-bladder are not tender, the discovery of the second or third areas of tenderness may, in conjunction with other symptoms, often decide the diagnosis. The presence of one or more of these areas indicates also that though no attack of colic may have occurred for some time, the patient still requires supervision and treatment."

I consider the search for this tender area a necessary part of the examination of all patients who suffer from gall-stone disease, or in whom the existence of this disease is suspected. It is undoubtedly a sign of great value.

Colic.—The pain experienced as a result of the irritation of gall-stones is often colicky in character. The exact cause of the colic has been much debated, and at the present time there seems to be no likelihood of general agreement upon the question. Kehr, Riedel, and others take the view that the colic is often or solely due to an inflammatory response to irritation in the gall-bladder or in some part of the ducts. They consider that the cholangitis so aroused lessens the calibre of the ducts, impedes the onward passage of their contents, causes an increased pressure behind the obstruction, and so gives rise to the colic.

Riedel tabulates the following as causes of gall-stone colic:

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1. Adhesions of a gall-bladder no longer containing stones. There is a circumscribed peritoneal irritation, with abdominal distension, more or less severe vomiting, and pain.
2. Adhesions when large stones are present in the gall-bladder and the cystic duct is patent.
3. Inflammatory processes in a gall-bladder distended by fluid or stones, when the cystic duct is occluded by inflammation or by the presence of a stone in the neck of the gall-bladder.
4. The transit of a stone through the bile passages.
5. The inflammation of a dilated, calculous common duct, or its tributaries, without impaction of the stone.

Riedel is of the opinion that a hydrops of the gall-bladder is present in all cases where the onset of the attack is sudden, as it is when a stone is about to be passed. If closure of the cystic duct is not present, the sudden onset of gall-stone colic is rare. The absence of symptoms in so many patients whose gall-bladders contain stones is due to the fact that the cystic duct remains patent.

On the other hand, many surgeons consider that the colic is always and inevitably due to spasm of the duct; that it is in the attempt of the duct, by overcontraction of its muscle, to expel an impacted body, that the cause of the colic is to be found. The characteristics of the colicky pain are the abruptness of its onset and the suddenness of relief. These are incompatible with anything which is inflammatory in character, and can only be explained by the sudden entrance and the equally sudden exit of a foreign body. The colic is due, therefore, to the passage of a stone or a foreign body of some kind

(a hydatid cyst, for example, I have once seen) down the ducts. The pain endures just so long as the body is moving. If impaction and fixity of the stone occur, the pain gradually lessens, and at length, probably after a few hours, disappears entirely, to be roused afresh when a further movement occurs.

Many surgeons have remarked that a high degree of infection of the gall-bladder and of the ducts may be present when no colic is or has ever been noticed. Both Riedel and Kehr, indeed, have given exemplary instances of both; of cases, that is to say, in which inflammation has been present without colic.

An attack of colic or of spasm is caused, therefore, only by an overexertion, of the nature of cramp, of the muscular wall of the gall-bladder or ducts in the onward passage of a foreign body. It is never found as the result of a gradually increasing distension of the gall-bladder or ducts; it is not aroused by inflammation, whether acute or chronic, in any part of the bile-tract; it is not found in cicatricial stenosis, nor in those cases in which a gradually increasing pressure is made upon the ducts from without. It is due to the sudden blockage of the ducts and to their exaggerated muscular efforts to rid themselves of the foreign body. It occurs only when this foreign body is in transit. As soon as the body becomes fixed the muscular efforts slacken and cease, and the ducts proceed to adapt themselves to the intruder. Small stones may pass along the cystic and common ducts without exciting pain. During operations for the removal of stones from the gall-bladder I have occasionally demonstrated the presence of small pebbles in the common

duct which have lain there without producing symptoms. The colic, when severe, is probably as terrible a suffering as a patient is ever called upon to endure. It comes on with absolute suddenness, produces a degree of collapse that may be profound, and soon induces faintness, sickness, and vomiting. The patient has terror written in every line of an anxious face. He is cold, and yet sweats profusely. His general condition, indeed, is at times alarming. The pain is often said by patients to "double them up." In their agony some slight relief seems to be gained by bending from the waist over a chair or couch, or, when sitting, by folding the arms across the epigastrium and by forcible flexion of the trunk. To see such a patient in the utmost extremity of his suffering is enough to convince one that a spasm, similar to the spasm of the intestine or of the ureter, is the cause of the intolerable pain.

This hepatic colic is the most characteristic and the most commonly recognised form of pain associated with gall-stones. It is present, however, in those cases only in which a stone is recently impacted or is in transit in the ducts. Since in the vast majority of patients a stone never enters on its travels from the gall-bladder, it is quite clear that hepatic colic is a far less frequently observed symptom than the dull, or the more acute, localised pains which have been previously mentioned.

If the stone while in passage through the ducts becomes for any reason arrested, the colic gradually ceases and in a few hours disappears. The stone may rest in its position for many years without causing spasm, but the moment it attempts to resume its journey the pain will

surely return and the colic will be as severe as before. Murphy has called attention to the fact that pain of the same character may be caused by the backward movement of a stone, as, for example, after a cholecystotomy, when a stone, impacted in the cystic duct, works its way backwards into the gall-bladder. Vermicular contractions of the gall-bladder or of the bile-ducts have never, so far as I am aware, been observed in man; but spasmodic muscular contractions of the wall of the gall-bladder and bile-ducts were observed by Haller and Müller in pigeons. Doyen and Oddi have observed them in rabbits, dogs, and cats. Simanowski was able to recognise spasm in the common bile-duct in animals, when foreign bodies were introduced into its lumen. A muscular hypertrophy has, however, been not infrequently found in the gall-bladder, and in some cases this may be so exaggerated as to cause the upraising of muscular bundles in the wall. Schüppel has described a specimen in which a fasciculation, similar to that seen in the urinary bladder, is found.

Gall-stones, it will be seen, cause pain, and therefore elicit recognition in one or two ways. Firstly, by causing irritation, infection, and inflammation as a result of their impaction in the neck of the gall-bladder or in any part of the ducts. Secondly, by traversing the ducts for a shorter or a longer distance, and in their movement setting up a spasm of the muscular wall, behind the stone. The pain caused in the former manner is, in some cases, a dull, in other cases an acute, pain, limited generally to the gall-bladder area. The pain caused in the latter manner is a spasmodic, colicky pain. In both there are

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radiating pains, spreading away from the gall-bladder region, sometimes to the right shoulder-blade, sometimes to the left, sometimes to the front of the abdomen and chest.

There has been a prolonged and a somewhat heated discussion as to the exact cause of the colicky pains in gall-stone disease. It is held by Riedel, Kehr, and others that the colic is due, as a rule, to infection and inflammation in the gall-bladder or the bile-ducts; by others, chief among whom is Murphy, it is asserted that colic is due to spasm of the gall-bladder or ducts, and is an indication of the fact that a stone or other foreign body is in transit through the ducts. Kehr writes: "The gall-stone colic depends almost always upon an inflammation of the gall-bladder," and, again, "The inflammation causes pain since the secretion collecting in the hollow organ stretches its walls." There can be no doubt whatever that in the great majority, if not in all, operations upon patients who have suffered from attacks of gall-stone colic there is evidence of old, often wide-spread, inflammation. But, although this must be allowed, it does not explain why an acute or subacute inflammation, even when leading to distension, should cause colic. The distension of other hollow viscera, as the result of inflammation, does not cause colic. With them, colic signifies an excessive, ill-regulated, spasmodic muscular action. In cases of dilatation of the stomach, as the result of pyloric obstruction, and in cases of intestinal obstruction of slow onset, a visible peristalsis can be recognised. It is always found that the onset of a colicky pain coincides with, and by the patient is recognised as being due to,

a well-marked spasmodic muscular contraction of the wall of the viscus. In the passage of a stone down the ureter the pain is always colicky in character. In fact, so far as we know, colic is never due to an increased tension alone; there must be added a spasmodic muscular contraction in the walls of the cavity. In cases of gall-stones it is universally admitted that it is the inflammation to which they give rise that in the vast majority of cases causes their recognition; and it is the inflammation which causes all pains other than the colic. Inflammation, by causing an increased secretion from the walls of the gall-bladder, or by altering the physical properties of the fluid contained therein, may indirectly be responsible for the excitation of a spasm. For the thickened, ropy, tenacious, or semi-solid bile, or mixture of bile and mucus, may, and almost certainly does, act as a foreign body. In the transit of this thickened material a spasm is excited and colic is experienced. My own view is that, though full allowance must be made for the supreme importance of inflammation in cholelithiasis, there is no evidence that colic is ever due to any other cause than spasm of the muscular wall of the gall-bladder or ducts; a spasm that is excited by the entrance into, or the attempted passage through, some part of the ducts of a stone, of altered bile, or mucus, or other irritating foreign body.

2. **Nausea and Vomiting.**—These are among the commonest of the manifestations of cholelithiasis. It is, indeed, their frequency which is responsible for the unjust and heavy burden which is laid upon the stomach. If one wished to frame an epigram it could be said, with

truth, that the most common symptom of gall-stones is indigestion. The indigestion has, as its natural and expected sequence, an attack of nausea and vomiting, which brings relief. The nausea and vomiting are partly reflex in origin and are partly due to the direct irritation of the stomach. In the majority of cases the feeling of deadly sickness and the vomiting which follows it are due to the impaction, momentary or enduring, of a stone in the cystic duct. Just as the passage of a renal stone from the pelvis of the kidney to the ureter is attended by the sudden feeling of intense prostration and sickness, so is the passage of a stone into the orifice of the cystic duct. It is the obstruction which reflexly produces the nausea and the vomiting. The vomiting when prolonged produces a general muscular relaxation and sweating, and in this flaccid and enfeebled condition of the patient the impacted stone falls back.

I have, in one patient, seen on two occasions the gradual filling up of the gall-bladder attended by persistent vomiting. The patient was a woman, thirty-four years of age, whom I saw with Dr. Carlton Oldfield. She complained of attacks of sickness and constant vomiting, and during these attacks a lump gradually formed in the abdomen. When the lump vanished, as it did almost suddenly, the vomiting ceased. The patient was admitted to the hospital and her story verified by observation. She began, quite suddenly, to suffer from faintness, nausea, and vomiting, and within a few hours the gall-bladder became palpable. Vomiting and enlargement of the gall-bladder continued for three days on one occasion, for five days on another, when the gall-

bladder disappeared almost suddenly and the vomiting and nausea instantly ceased. At the operation no gall-stone was found. The gall-bladder was very large, thick, and flaccid. The obstruction at its neck was due to a sharp kink, aided very probably by a large gland lying close to the cystic duct.

In all patients who suffer from constant attacks of nausea and vomiting it is desirable that the possibility of the existence of gall-stones should be borne in mind. The examination of such patients should include an attempt to elicit the pressure sign to which reference has already been made.

3. **Jaundice.**—Jaundice is a rare symptom of gall-stone disease, unhappily. If jaundice occurred more frequently than it does, there would be an earlier and more frequent recognition of the disease. It is, however, an inconstant, and often an inconspicuous, symptom. Murphy, whose experience of the surgery of gall-stones is very considerable, found that jaundice was present in only 14 per cent. of his patients at any time during the course of their disease.

Wolff stated that jaundice was present in 50 per cent. of the patients in whom a diagnosis of gall-stones was warranted by a discovery of stones in the fæces. Fürbringer found jaundice is only 25 per cent. of his cases.

In some patients, owing to a natural sallowness of the skin, the presence of jaundice may be difficult to determine. I have found a suggestion made by Hamel to be of great value in this and in like circumstances. A capillary tube is taken and blood allowed to flow into it from a puncture made in the lobe of the ear. After

standing for a few hours the serum should collect in the upper part of this tube; normally it is quite colourless, but if even the faintest tinge of jaundice be present, a yellow colour will be readily perceived in the serum.

Jaundice in cholelithiasis depends upon one or other of two factors: impaction of a stone in the hepatic or common ducts, or, rarely, of a large stone in the cystic duct, causing pressure on the common duct; or infection of these ducts. The impaction of a stone in the cystic duct does not cause jaundice unless the hepatic or common ducts are also involved. If they remain intact, jaundice does not occur.

Jaundice varies greatly in the character of its appearances and of its vanishing. When jaundice is due to gall-stones it is, almost without exception, preceded by colic. The pain comes a few hours or a few days before the tinge of jaundice is noticed, and a rough proportion holds between the intensity of the colic and the depth of the jaundice. The jaundice, as a rule, appears gradually and deepens more or less rapidly, according to the completeness of the obstruction to the onflow of the bile. If, after attaining a certain depth, it passes gradually away, the obstruction to the duct has been relieved. If, however, a stone becomes impacted in the duct and the duct dilates behind it, a ball-valve action results, as shewn by Fenger, and the jaundice is remittent. It varies,—that is, in depth of tinge,—but never clears completely away. There is always a perceptible yellowness of the conjunctivæ and of the skin of the abdomen. The degree of discolouration may vary not only from day to day, but from morning to night, being slighter on

rising in the morning and deepening slowly during the day.

If a stone be impacted in the cystic duct it may give rise to jaundice by arousing an acute inflammation which spreads down to the common duct, and there causing a swelling and thickening of the mucosa, resulting in an incomplete block to the downward passage of the bile. If a stone be impacted just as its tip is entering the common duct, similar attacks of cholangitis are caused. In both these instances, however, the jaundice clears off entirely in the intervals between the recurring attacks of inflammation; that is, the jaundice is intermittent, not remittent.

By contrast with this the form of jaundice met with in malignant disease may be mentioned. If there be a cancer of the head of the pancreas, and obstruction to the common duct result from the pressure of the enlarging growth, jaundice will be a symptom of the gradually increasing difficulty that the bile experiences in passing down a narrowed channel. The jaundice will appear quite gradually and painlessly; it will deepen day by day by almost imperceptible degrees, until the colour of the skin is a deep greenish yellow. There will be neither remissions nor intermissions, but a steady and progressive deepening. Pain is never present. I am of opinion that there is a decided difference in the colour of the jaundice in simple and in malignant cases. In the former the golden-yellow colour, in the latter, the green, predominates.

The importance of the association of distension of the gall-bladder with jaundice was pointed out many years ago by Courvoisier. In the large series of cases whose records were examined by Courvoisier, it was found that

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in a little over 80 per cent. of cases of gall-stones in which persisting jaundice was present, the gall-bladder was contracted. The inflammatory changes, due to long-standing and oft-repeated attacks of infection of the gall-bladder in the cases of impacted stone, result in a thickening of its walls and in a marked contraction of its cavity. In many cases the gall-bladder is no thicker than a lead pencil; in others its cavity will barely contain the ordinary probe. Distension of such a gall-bladder is a physical impossibility. When, therefore, a distended gall-bladder is found in association with jaundice, there is a very strong probability that gall-stones are not the cause of the symptoms. In a certain number of such cases the distension of the gall-bladder may be due to a stone impacted in the cystic duct, which causes recurring waves of inflammation to spread along the cystic to the common duct, or the stone may project by its tip from the cystic into the common duct. In one case I have seen the gall-bladder enormously distended by hydatids which had burst into it from a large hydatid cyst in the right lobe of the liver; other hydatids blocked the common duct from end to end, distending it to a diameter of about one and one-half inches. Jaundice was, of course, persistent. The case, indeed, was diagnosed as one of malignant disease of the pancreas; no operation was performed, as the patient became maniacal and died within a few days of her admission to the Infirmary.

Courvoisier further pointed out that when persisting jaundice was associated with distension of the gall-bladder, the cause was, in over 90 per cent. of cases, an obstruction of the common duct by pressure from without.

The most frequent cause in such circumstances was malignant disease of the head of the pancreas. The exact figures given by Courvoisier were as follows:

There were 187 cases of obstruction of the common duct from all causes. Of these, 100 were due to obstruction from causes other than stone, and 87 were due to obstruction by stone. Of 100 cases in which the obstruction was due to causes other than stone, in 92 cases there was dilatation of the gall-bladder; in eight cases there was a normal gall-bladder or an atrophy of the gall-bladder.

Of 87 cases in which the obstruction was due to stone, in 70 cases the gall-bladder was small and atrophied; in 17 cases the gall-bladder was dilated.

All these cases were collected from the literature. Of the cases that came to operation and were recorded by Courvoisier, 35 in number, in 18 the obstruction was due to causes other than stone, and in 16 of these there was dilatation of the gall-bladder; in 17 the obstruction was due to stone, and in 13 of these the gall-bladder was



FIG. 39.—A dilated gall-bladder measuring eight by six inches due to cancer of the head of the pancreas (Guy's Hospital Museum, No. 1392).

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contracted. In several cases I have seen a chronic indurative pancreatitis produce jaundice with an enlarged gall-bladder. These observations of Courvoisier's were formulated by him in the following statement, which is now generally referred to as "*Courvoisier's Law*":

"In cases of chronic jaundice due to blockage of the common duct, a contraction of the gall-bladder signifies that the obstruction is due to stone; a dilatation of the gall-bladder, that the obstruction is due to causes other than stone."

The validity of this law has been closely investigated and its truth has been affirmed by almost every writer. The earliest confirmation of it was afforded by the independent observations of Mayo Robson, published in 1892. He wrote: "Distension of the gall-bladder, accompanied by jaundice, has in all the cases which I have observed, and in those cases where I have operated, turned out to be dependent on cancer, either of the head of the pancreas or of the common duct."

Ecklin, in 172 cases of common duct obstruction, due to calculus, found that 28, or 16 per cent., had dilatation of the gall-bladder; 144, or 84 per cent., had contraction of the gall-bladder. In 139 cases of obstruction due to other causes 121, or 87 per cent., had dilatation of the gall-bladder.

A further examination of the question has been made by Dr. A. Cabot, of Boston, who collected the records of the Massachusetts Hospital. There were 86 cases of obstruction of the common duct. Of these, 57 were due to obstruction by stone; in 47 the gall-bladder was atrophied,

in eight it was normal, and in two enlarged. Twenty-nine cases were due to causes other than stone; in 27 the gall-bladder was distended; in one the gall-bladder was empty, and in one contracted around three stones. Only four cases, therefore, in this series did not fall in with Courvoisier's law. Cabot writes: "With the exception of these four cases, which constitute only 5 per cent. of the total number examined, every record of the Massachusetts Hospital series in which definite statements are to be found concerning the points at issue goes to confirm Courvoisier's law."

The explanation given by Courvoisier of the occurrence of sclerosis of the gall-bladder in cases of stone was that the presence of calculi in the gall-bladder, and their passage or attempted passage down the ducts, had caused irritation and inflammation in and around the bile passage. Cholecystitis and peritonitis were the result and had resulted in the cicatricial cramping and compression of the gall-bladder.

Fenger, criticising this statement, offers the explanation that "the atrophy in these cases, hitherto incomprehensible, is easily explained by the ball-valve action of a floating choledochus-stone at the distal end of the cystic duct." This, however, leaves out of consideration the numerous cases where the stone is not found at the spot mentioned. Elsewhere Fenger attributes the emptiness of the gall-bladder to a floating stone "in or near the cystic duct."

The great probability is that the explanation of Courvoisier is entirely correct. The sclerosis of the gall-bladder is a matter of old standing and is present long

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before the impaction of the stone. Fenger's explanation would account for the emptiness of the gall-bladder in a few cases, but not for the cicatricial contraction present in the great majority.

4. **Fever.**—The elevations of temperature caused by infection due to gall-stones are characterised by their abruptness. The temperature rises rapidly, attains its maximum, and then, with almost equal speed, returns to the normal. Between the attacks of infection the temperature remains approximately normal. When the infection is limited to, or chiefly affects, the gall-bladder, there is a rise of temperature up to 101° – 104° , according to the severity of the infection. In the slighter cases the temperature rises to 101° , and some local tenderness is developed, but within two or three days all returns to the normal. In the severer cases a rigor may occur, and the infection may be so severe that an acute cholecystitis, or a phlegmonous cholecystitis, may develop, and the plight of the patient is serious indeed.

In many cases it is found that the elevation of temperature or the occurrence of a rigor precedes the onset of pain. The acute inflammation in the gall-bladder causes a rise to 101° or higher, and is responsible for the increased effusion from the mucosa into the gall-bladder; and it is this which, in its turn, causes an increase of tension and pain. If there are repeated attacks of cholecystitis, the temperature does not remain high in the intervals, but rises abruptly at each fresh infection and soon returns to the normal. If, however, suppuration occurs, then a continuous elevation of temperature to 101° or 102° may be found.

Budd, Schmidt, Schüppel, and others of the earlier writers spoke of the rigors and the elevations of temperature as "nervous" in origin and as comparable with the rigors of urethral fever. We now recognise that both this fever and urethral fever are bacterial in origin, the result of an undoubted infection.

When there is stone in the common duct, an attack of colic is followed by or accompanies a rigor, sometimes severe, sometimes in miniature. The temperature again rises abruptly and again quickly descends. Between such attacks the temperature may be normal.

A temperature chart, shewing these attacks of infection, represented by an abrupt, peak-like elevation with the normal interspace is most characteristic. In describing the chart to students I am accustomed to calling it the "steeple" chart.

The occurrence of these angular elevations in the chart recording the temperature is quite pathognomonic of gall-stone disease. I am not aware that any other charts, except perhaps those of malarial fever, resemble these to a degree which can cause a doubt in the mind of the surgeon. Murphy speaks of the "temperature angle of cholangic infections." He writes (*Med. News*, vol. 1, 1903, p. 830): "The temperature in an hour will rise to 104° or 105° , remain stationary for a few hours, and then drop as suddenly to normal, and remain normal for hours, days, or even weeks, when it will go through the same rapid variation and continue to repeat itself at irregular intervals." And again: "These temperature changes are so characteristic that I have given

them the name of 'the temperature angle of cholangic infection.' "

These characteristic charts are reproduced by both Charcot and Naunyn, though their perfectly characteristic appearance does not seem to have been remarked by either. Charcot, in his original account of "intermittent hepatic fever," depicted a most excellent "steeple" chart, a part of which is reproduced in Fig. 46.

In later stages of acute disease, when the intense infection has spread throughout the finer bile channels in the liver, the temperature may show no remissions, but remain persistently high. In such cases the temperature may range from 103° to 105° , and never return to the normal. As a rule, fever of this type follows the intermittent fever previously described, and is a sign of a more generalised and more intense infection.

5. **Tumour.**—A tumour of the gall-bladder in cholelithiasis occurs as a result of a block in the cystic duct, by a stone, by the enlargement of a lymphatic gland, or by torsion or flexion at the neck of the gall-bladder. It occurs also when there is obstruction to the common duct by enlargement, simple or malignant, of the head of the pancreas. In rare cases an enlargement of the gall-bladder, due solely to its being crowded with stones, may be recognised on palpation of the abdomen. Several observers have been able to grasp the gall-bladder and to feel the stones therein rubbing together. Petit, in 1743, speaks of a gall-bladder feeling "like a bag of nuts" when distended with stones. Lessdorf was able to invaginate his hand within the abdomen through the neck of a large umbilical hernia and to grasp a

stone-containing gall-bladder. I have once, in the lax and pendulous abdomen of a multipara, been able to feel a gall-bladder filled with stones, to recognise that its shape was hour-glass, and at the operation, a few days later, to verify my observation.

When a stone is impacted in the pelvis of the gall-bladder or in the cystic duct, the gall-bladder distends behind the block. The fluid contained within it may at first be deeply tinged with bile, but soon all trace of colouring matter disappears, and a condition of hydrops exists in which a clear or opalescent mucoid fluid is found. If there is infection, the fluid becomes purulent and a condition of empyema of the gall-bladder is recognised.

A distended gall-bladder which contains bile is due to pressure upon the common duct by growths or chronic inflammation in the pancreas, or by growths originating in closely adjacent structures.

A tumour of the gall-bladder may be due to malignant disease, which, in the majority of instances, is a late result of gall-stone irritation.

The tumour formed by the enlarged gall-bladder is generally easy to recognise. It forms a prominence visible on inspection of the abdomen in some instances, and in many is readily appreciated as lying just beneath the abdominal wall. It is generally pear-shaped or like a banana in form, smooth in contour, and may sometimes possess a range of considerable mobility, swinging pendulum-like from side to side, reaching, in some cases, as far as the left hypochondrium. As a rule, the swelling is tender, and a feeling of nausea

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is excited upon handling it. Immediately above the tumour can be felt the edge of the liver. The colon on inflation is found to lie below it, or, rarely, beneath it, though in one case I have found the colon to be adherent to the edge of the liver above the gall-bladder, so that on inflation the swelling was recognised as being below the colon and made less easily palpable. Lawson Tait and Lücke have described cases in which the small intestine was adherent in this position. A large mass of thick omentum over the gall-bladder may blur the outline of the tumour, so that its characteristic shape is not recognisable. Inflation of the stomach is often a useful aid to diagnosis. A gall-bladder tumour in this way is displaced to the right and a little upward, and, as Naunyn has pointed out, it may become pushed against the abdominal wall and therefore be more distinctly palpable. The attachments of the tumour to the liver may be recognised by their simultaneous descent when the patient breathes deeply. The tumour cannot be held down during respiration, but moves upward and under the hand at precisely the moment when the ascent of the liver begins. Other tumours, those, for example, of the kidney, or stomach, or colon, or omentum, can be held downwards when grasped at the end of a full inspiration. In some cases the extent of the projection of a gall-bladder beyond the margin of the liver is no criterion as to the size of the gall-bladder or as to its capacity, for in several instances where little more than the rounded fundus can be felt, or seen after the abdomen is opened, there may be a considerable dilatation of the part concealed by the liver, and on

aspiration 15 to 20 ounces of fluid may be removed. In many cases of old-standing cholelithiasis, the lower edge of the liver is dragged down to the right and in front of the gall-bladder into a tongue-shaped lobe which is generally known as the "linguiform lobe of Riedel."

Further reference to the characters of a distended gall-bladder will be made in discussing the condition of "hydrops "

A tumour found in the neighbourhood of the gall-bladder may be caused by an adhesion of an enlarged gall-bladder to the abdominal wall. Stones therein contained may then ulcerate through into the abdominal wall. In such cases a tumour which closely resembles, in its physical characters, a growth in the muscles of the abdominal wall may form. The tumour is hard, rounded, smooth, and fixed, but it is not adherent to the skin. Mordret and Michaux record examples of this kind. (Bull. et Mem. Soc. de Chir., vol. 29, p. 1189.)

Enlargement of the liver may be noticed in many cases where gall-stones are passing down the ducts or attempting to do so. As a rule, in all gall-stone attacks the liver enlarges and becomes tender. In some cases the increase in size is remarkable. Naunyn remarks: "I have seen a previously normal liver examined by myself so to increase in size in the course of a few days as to extend as far as the hypogastrium as a quite massive tumour, and this not by any means only in cases with severe colic, but even in those with slight pain and hardly perceptible jaundice." The recession of the

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hepatic enlargement is generally rapid and complete unless further attacks follow or there is abscess or malignant disease.

THE DIFFERENTIAL DIAGNOSIS OF GALL-STONE DISEASE.

To discriminate between gall-stone disease and many other affections producing pain, localised or general, within the abdomen, and radiating to the chest and back, with vomiting and perhaps collapse, is often a matter of difficulty, and is sometimes impossible of achievement. Nevertheless, it is a fact that the diagnosis of gall-stones is often made readily and with certainty. This has been more apparent during recent years since the earliest stages of the disease have been recognised and dealt with by the surgeon. The "prodromal stage" of cholelithiasis described by Kraus, upon which Naunyn threw doubts, is not the stage, as he thought, of the formation of gall-stones; it is the stage in which gall-stones insidiously formed are beginning to cause discomfort. Nothing is more certain than this, that in the majority of cases of cholelithiasis the symptoms in the earlier stages are not ascribed by the patient to the presence of gall-stones, but are referred to "spasms," "indigestion," or other equally indefinite diseases.

The various diseases with which gall-stone disease may be confounded are gastric ulcer, or, rarely, carcinoma; duodenal ulcer; appendicitis in its varied forms; diseases of the right kidney, more especially calculus, or that intermittent kinking of the ureter

or of the vessels of the kidney which causes Dittel's crises; lead colic; affections of the right pleura or lung, and the gastric crises of locomotor ataxia. Among rarer conditions may be mentioned aneurysm of the hepatic artery, which was first noted by Riedel, and has since been observed by Kehr, and a diffuse syphilitic hepatitis, both of which have given rise to grave difficulties in diagnosis.

CHAPTER V.

THE SPECIAL SYMPTOMS IN GALL-STONE DISEASE.

In discussing the symptoms of gall-stone disease Naunyn has described two forms of cholelithiasis—"regular cholelithiasis" and "irregular cholelithiasis." Of regular cholelithiasis he writes: "This then is the regular course of cholelithiasis that the concretions traverse the bile-duct and enter the duodenum without doing any considerable amount of permanent damage." The use of the term "regular," therefore, is held as applying to that form of the disease which manifests itself in the classic gall-stone "attacks." It is an unfortunate term if it suggests that such attacks are the common or even a usual manifestation of the presence of gall-stones. It is certainly only in a small proportion of the cases that come to operation that regular cholelithiasis is seen. Gall-stones arouse symptoms that are dealt with by operation in a very large number of cases when nothing in the nature of a "regular" cholelithiasis has been observed. Naunyn's work was, of course, based mainly upon clinical and postmortem investigation, the ripe harvest of operative experience was only then being sown.

In discussing the symptoms and in describing the pathology of the various forms of gall-stone disease it will, therefore, be desirable to consider, firstly, the

signs and symptoms which result in "regular cholelithiasis,"—that is, in those attacks in which a stone leaves the gall-bladder, traverses the cystic and common ducts, and finally escapes into the duodenum,—and, secondly, the signs and symptoms which are caused by the arrest of the stone in any part of this course.

First.—The symptoms due to the passage of a stone from the gall-bladder to the duodenum.

As a rule, the patient will have had previous warning that there is something wrong in the abdomen, and a diagnosis of gall-stones confined to the gall-bladder may have been made. In an "attack" of the kind now to be described the pain generally commences with absolute suddenness. There are many conditions which, by individual patients, are recognised as being inciting factors, such, for example, as the onset of menstruation, the ingestion of an unduly hearty or indigestible meal, an attack of diarrhoea, due to irregular feeding or perhaps to the taking of an aperient, and so forth. In a certain, perhaps not inconsiderable, number of patients a recent attack, one among a series, of appendicitis may have been experienced. Some patients are able to predict the onset of an attack by the feeling of unusual heartiness and vigour which they experience. In the days preceding an attack there may be a better appetite and food may, therefore, be taken in larger quantity. This is probably due to the fact, to which Ewald and others have drawn attention, that hyperchlorhydria often precedes an attack for two or three days. The pain usually comes late in the day, in the afternoon or evening, or, espe-

cially in the first attack, as Naunyn has said, at midnight. It increases rapidly, becomes spasmodic in character, and radiates to the shoulders, to the epigastrium, to the chest and neck. The pain, when attaining its height, is generally said to cause the patient to be "doubled up," or to roll in agony upon the floor. It induces collapse, a feeling of nausea, and vomiting. The pain may last continually, without even the smallest intermission, for hours, or it may be lulled for a few moments, only to be renewed with equal severity. When most intense, it seems to prevent the patient from taking a deep breath, and the open hand is held protectingly over the hepatic area, forming, as it were, a splint. The vomiting, which soon follows, seems to give some measure of relief; bile is often, indeed as a rule, present in the vomit. There may be a feeling of intense depression, and the patient may shiver with the cold. The occurrence of a rigor with a temperature of 103° or 104° is rare, though not unknown. Naunyn says "very commonly severe rigors accompany the colic attacks," a statement which is not in accordance with the observation of many authors. "Severe" rigors are almost unknown in the classical "*gall-stone attack*," though slight shivering followed by sweating is commonly observed. In some instances tetany may be seen. In one patient, a lady of twenty-seven, who suffered for two years from gall-stones, the tetanic seizures caused even greater suffering than the colic. The pain may persist for hours or even days, and may end gradually, or with as marked a suddenness as occurred at the onset. A feeling of stiffness or soreness

is left for days, the patient often saying that the side "feels bruised." During the pain or soon afterwards jaundice is noticed, with the appearance of bile in the urine and the absence of bile in the motions. Bile is often noticed in the urine before a tinge of yellowness is seen in the conjunctivæ. The clay-coloured appearance of the stools is not invariable; it may be absent even when jaundice is present in the skin, and the urine shews the colour of bile. There is not seldom a troublesome itching of the skin, which appears before the jaundice, and may remain when the jaundice has quite cleared away, or more commonly may disappear some days before the jaundice. During the attack the pulse rate is said by Naunyn to be slow. This is not in accordance with my own experience. I have not found any reduction in the pulse rate in jaundice unless a degree of chronic pancreatitis is present. Constipation is present after and during the attack, appetite is lost, and there is a feeling of general ill-health. The tongue is foul and thirst is often unquenchable. The liver and the spleen are generally enlarged, and the former is very tender. The gall-stone, which is the cause, in its transit through the duct, of all these symptoms, is passed into the duodenum and may be recovered in the motions. "In regular cholelithiasis," Naunyn writes, "the stones are passed in the motions. They are often sought for in vain, but such failures are usually due to the examination of the stools being not carried out continuously or over a long enough period." The reasons for the want of discovery of stones in the fæces are thus given by Naunyn:

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- “1. The stone, after having been driven into the neck of the gall-bladder, may have fallen back into the bladder. This can hardly be a common event.
- “2. The stone may have remained fixed, whereas the patency of the duct has been restored.
- “3. The concretion may have disintegrated in the bowel.”

It is not improbable that the condition first mentioned is, as a fact, distinctly a common event, if not *the* most common event, in patients who harbour stones in the gall-bladder. An attack of this kind may be the first and the only attack from which a patient suffers. Such an event is, however, extremely rare. Other attacks follow with greater or less frequency, and with more or less modification other complications may develop, and “irregular” cholelithiasis in any of its varied forms may be seen.

The symptoms detailed above are those which are due to the passage of a gall-stone from the gall-bladder to the duodenum. In the case of patients operated upon for gall-stones by the surgeon a history which suggests that such a transit has occurred is decidedly rare. In my own experience it is present in less than 20 per cent. The great majority of the operations practised to-day are advised because recognition is made of the nature of the disease in an earlier stage than this.

The presence of albumin in the urine during and for some time after an attack has been not seldom observed. It is, however, by no means constant and has no diagnostic significance.

Second.—Under this heading are to be described the symptoms which are caused by the arrest, temporary or permanent, of a stone, at any part of its course from the gall-bladder to the duodenum, and, in brief, the pathological changes which are thereby invoked. It will be convenient to consider the subjects in the following order:

- (A) Stones in the gall-bladder.
- (B) “ “ cystic duct.
- (C) “ “ hepatic duct.
- (D) “ “ common duct, including the ampulla of Vater.

(A) STONES IN THE GALL-BLADDER.

In all cases of cholelithiasis it is the inflammation which the stones arouse, rather than the stones themselves, which is responsible for the production of the chief symptoms. In a large number of cases gall-stones are found at a postmortem examination when no evidence of their existence has been observed during life. Quincke, for example, writes: “In many, in fact in the majority, of the cases of concretions within the gall-bladder or the bile passages, all symptoms are absent and the condition is only discovered at autopsy.” This statement and all the similar ones to be found in text-books of medicine are probably exaggerated. They do not take into account the facts, made clear by the experience of the surgeons, that what were formerly considered the typical symptoms and signs of gall-stones are present in very few cases of cholelithiasis. The commonest symptom of gall-stones is not referred to

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the biliary passages at all. It is "indigestion" in the patient's vocabulary. Riedel, in a recent paper, states that of 100 cases of epigastric colic ("stomach cramp"), 97 are due to gall-stones. In a patient who has suffered for years from "gastric neuralgia" the discovery of gall-stones at the autopsy is not always held to explain the symptoms.

It will, however, be allowed by all surgeons that the presence of stones in the gall-bladder does not necessarily cause symptoms, for gall-stones are occasionally found during the performance of other abdominal operations, when a close enquiry subsequently fails to elicit any history of symptoms. Something more than the mere presence of the stones is, therefore, necessary to arouse the knowledge of their existence. This may be:

1. A sudden movement among the stones, a disturbance or disarrangement of them, however excited.
2. The impaction of a stone or stones in the cystic or common or hepatic ducts.
3. Infection of the gall-bladder or any part of the bile-tract.

The bacillus coli is the organism most often found, but in cases of suppuration the staphylococcus pyogenes aureus or albus may also be present. Ehret and Stolz (Berl. klin. Woch., 1902), in order to discover the cause of the sudden onset of symptoms of an acute infective character in cases of cholelithiasis, fed dogs, into whose gall-bladders sterilised glass balls had lain for three months without causing symptoms, upon decomposing meats. An acute enteritis was set up and was followed

by a purulent cholecystitis. The infection in these cases was an ascending one from the duodenum. Any irritating or decomposing food may not only introduce fresh organisms into the intestine: it may also tend to increase the activity of any that may be already there. When stones are contained within the gall-bladder, the symptoms which they cause are therefore, due to one or other or all of the causes above mentioned. It is probable that disarrangement excites infection, the mere moving of the calculi, apart from some traumatism to the gall-bladder and subsequent infection, being unlikely to excite any symptom. The symptoms therefore of gall-stones in the gall-bladder are those of cholecystitis, and they vary in severity precisely in accordance with the intensity and virulence of the infection.

In acute cholecystitis there are pain, nausea and vomiting, collapse, great local tenderness, and perhaps swelling and fever. The pain comes on suddenly and is of great severity; it affects the whole of the right hypochondrium, radiates to the back and over the front of the abdomen and chest. It is of such intensity in the more acute forms that the patient may roll in agony on the floor. His face is then anxious and drawn and ashen-coloured, he sweats profusely and is cold, and his pulse may be extremely feeble. There are nausea and repeated vomiting, and bile is not seldom present in the vomit. The gall-bladder may be palpable, but is more often protected by a rigid covering of muscle, made tense by the irritation and inflammation beneath. Jaundice is but rarely present, and is then due to an

extension of the inflammation down the cystic to the common duct. It is probably not present in more than one or two per cent. of cases of cholecystitis. The symptom to which many patients refer is a stiffness or soreness or sense of bruising in and about the right hypochondrium for two or three days after an acute attack of pain. This, which is similar to that felt before a subacute perforation of an ulcer of the stomach, is probably due to a localised but subdued form of peritonitis. A patient suffering from this will hold the hand firmly pressed to the side when walking up or down stairs or in attempting to bend. In those cases where a stone is temporarily impacted in the cystic duct, the symptoms are always more severe. The temperature is higher, even to 104° , and there may be a rigor. The temperature chart shews then the characteristic "steeple" form—a sudden rise to a great height followed by a fall to the normal. There is more serious depression and the vomiting is more exhausting. The patient's condition is indeed serious. In some such instances the infection may be so intense as to lead to ulceration or gangrene of the gall-bladder or to empyema. If the stone drop back into the gall-bladder, the infection generally subsides rapidly, and in a week, or rather longer, the condition of things may return to the normal. After a respite all the symptoms may be repeated in an attack of mild or great severity. After one or more such attacks a condition of chronic cholecystitis persists, and the gall-bladder may present a variety of aberrations from the normal. It may be small, shrunken, or shrivelled, with thin fibrous walls and a

cavity that is barely to be recognised. In one such example it was at first thought that the gall-bladder was absent, and it was only after a tedious and prolonged postmortem dissection that an insignificant remnant of it was laid bare. In other cases a thick gall-bladder, intimately adherent to omentum, duodenum, or colon, may be found, and in the cavity of this a small quantity of thick viscid mucus. Or in still others the gall-bladder may be a little thickened and adherent, its walls are opaque, white and stiffened, but bile may still enter the bladder, as a reservoir.

When chronic cholecystitis is present, there is almost always a constant dull aching, sometimes hardly perceptible, sometimes of severe degree, in the right hypochondrium. The pain, during any exacerbation of the inflammatory process, may be temporarily more acute. It is in this form of disease that the differential diagnosis is most difficult. The symptoms are dull, diffuse pain of the type mentioned; a feeling of fullness, flatulence, or distension coming on during a meal, often after the first few mouthfuls have been swallowed, occasional backache, or aching in the shoulder and probably constipation. In the symptoms there is, it will be seen, nothing characteristic, nothing that by many surgeons would be considered even suggestive of cholecystitis or of any form of gall-stone disease. It is in this class of cases that the pressure sign is of the greatest help. It is the inability of the patient to take a full, deep inspiration when the surgeon's fingers are hooked up deep beneath the right costal arch, below the hepatic region. If the tips of the fingers be "worked in" gradually until

the muscles have relaxed and the liver edge can be felt, then, as soon as the patient takes a deep breath, the tender, chronically inflamed gall-bladder is forced downwards against the fingers and the inspiration suddenly stops, ending in a deep sighing or brisk expiratory effort. When an acute infection leading to suppuration occurs, it is generally the result of a block in the cystic duct. Gall-stones contained within the gall-bladder rarely cause pressure symptoms.

The following case of death from pressure of gall-stones contained in the gall-bladder on the vena porta is recorded by A. S. Donkin (Med. Times, 1868, vol. 2, p. 396):

The patient was a man aged fifty-six. On April 4, 1868, he had a hearty supper and went to bed in his usual health. About midnight he awoke in great agony with intense pain in the abdomen and vomiting of fluid deeply tinged with bile. The pain and vomiting continued up to April 7th, when nine leeches were applied to the epigastrium without giving relief. On April 8th the pain had almost subsided, but there was great tenderness over the region of the stomach and the vomiting was incessant. The patient gradually became worse and died.

Postmortem.—The great omentum was deeply congested and clots of dark blood were scattered between its fold; the lesser omentum was less highly congested. The mesentery was congested, but to a much less degree than the greater omentum. The ascending mesocolon was extravasated between its folds. This congestion extended to the transverse mesocolon, but to a much less degree. The cæcum was highly congested, while the ascending colon opposite the seat of hæmorrhage in the mesocolon was so intense that it presented through-

out on its mucous surface a blackish colour from engorgement of its minute vessels and ecchymosis. The stomach contained a considerable quantity of fluid; the rest of the intestines were quite empty. The mucosa of the stomach everywhere showed venous congestion. Several large blackish patches were observed on its surface in the region of the greater and lesser curvatures. The duodenum was highly congested, while the jejunum and ileum were only slightly so. The liver was quite healthy. The gall-bladder contained three large calculi of about equal size. Together, in the gall-bladder, they formed a hard solid tumour whose posterior extremity rested in the portal fissure over the portal vein where it enters the liver, thus producing mechanical compression of the portal vein to such a degree as to give rise to all the phenomena of congestion of its tributary trunks and the resulting hæmorrhages. The muscular coat of the gall-bladder was atrophied, with thickening of the external coat, which had assumed a whitish colour.

(B) STONES IN THE CYSTIC DUCT.

The impaction of a stone in the cystic duct may cause a great variety of results in the gall-bladder. These may be enumerated as follows:

- | | |
|--|--|
| (a) Dilatation of the gall-bladder.. | { simple hydrops,
empyema. |
| (b) Acute cholecystitis | { catarrhal,
suppurative,
gangrenous, or
phlegmonous. |
| (c) Sclerosis of the gall-bladder. | |
| (d) Calcification of the gall-bladder. | |

The frequency of this impaction has been very vari-

ously estimated by different writers. Langenbuch found stones in the cystic duct in one-third of the cases upon which he operated, Riedel in two-thirds. Schlott, basing his figures upon a series of postmortem observations at Basle and at Erlangen, found stones in this duct in only 5.5 per cent. of cases of cholelithiasis.

(a) **Dilatation of the Gall-bladder.**—When a stone becomes impacted in the pelvis of the gall-bladder or in the cystic duct, there is a rapid distension of the gall-bladder behind the obstruction. At the first the fluid therein contained consists of bile-stained mucus, but as the obstruction becomes chronic the bile is absorbed and at last disappears entirely. The fluid then consists only of mucus, which may be clear, turbid, or opalescent; it is generally alkaline in reaction and contains albumin. I have found it sterile in old-standing cases. In recent cases the bacillus coli is generally present. In both crystals of cholesterin are seen. The overfull gall-bladder, due to obstruction of the cystic duct, never contains bile alone. When the gall-bladder is tightly distended and contains bile, there is almost always an obstruction of the common duct, due to other causes than gall-stones. The distended gall-bladder soon becomes palpable and projects from beneath the edge of the liver. It may reach an enormous size, and in a few examples, recorded by Lawson Tait and others, the swelling has been mistaken for an ovarian cyst. The wall of the gall-bladder is generally thin, in proportion to the quantity of fluid, but in some instances there may be an abundant deposit of fibrous tissue and the cyst wall may be grossly thickened. The lining



FIG. 40.—A dilated and thickened gall-bladder containing seven large gall-stones, one of which, nearly one inch in diameter, is tightly impacted in its cervix and completely obstructs the passage into the cystic duct. The patient, a gentleman sixty years old, died with a strangulated hernia (Royal College of Surgeons' Museum, No. 2815).

membrane of the gall-bladder loses its normal reticulation and becomes rough, coarsely granular, and sodden in appearance.

A condition of hydrops may result from any form of obstruction to the cystic duct; as, for example, stricture due to an old ulceration caused by gall-stones, kinking, enlargement of the lymphatic gland outside the sigmoid curve, or growth in or around the duct. In a few cases it is said that no obstruction of the duct has been found. The probability is that in such instances there has been a sharp kink in the duct, which, on postmortem examination, has been undone by the removal of the specimen. The cystic gall-bladder may enlarge gradually during many years, or may remain unaltered. A very remarkable specimen from a case of Mr. Skey's, in the Museum of St. Bartholomew's Hospital, shews an enormously distended gall-bladder, a part of which was found as the 'content of the sac of a femoral hernia.

The gall-bladder when enlarged forms a tumour which is pendulous from the liver. It is club-shaped, the narrowed end being the stalk of attachment to the liver. A very wide range of movement is often possible, the tumour being readily made to present well to the left of the umbilicus.

The symptoms caused by impaction of a stone in the cystic duct are, as has been said, very acute at the time of the occurrence, but if the obstruction becomes chronic and a hydrops results, the symptoms may be singularly few, or may be absent altogether. The pain loses its colicky character very early, and there may

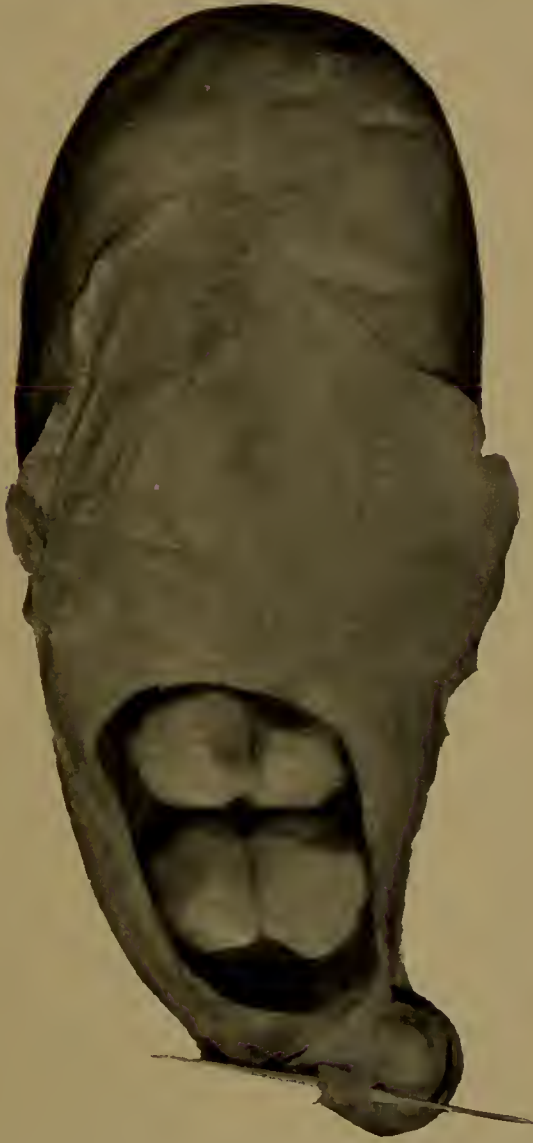


FIG. 41.—A gall-bladder, measuring $5\frac{1}{2}$ inches in length, due to the impaction of a calculus in the cystic duct. In its cavity lay the other four calculi shewn. From a woman, aged twenty-eight, who had suffered from pain in the right hypochondrium for about two years, but had never been jaundiced. She made a rapid recovery (Royal College of Surgeons' Museum, No. 2830 f).

be merely a dull ache or a trivial sense of discomfort. The tumour is not necessarily tender, though the free handling of it often causes a feeling of nausea.

The tumour is to be recognised as being caused by the gall-bladder; by its attachment above to the liver, the lower edge of the liver being traceable to its upper end; by the fact that it does not fill the loin and cannot be made to bulge by forward pressure in the flank; by the fact that inflation of the colon displaces it forwards or upwards, and not downwards (except in those extremely rare cases in which the colon is adherent at the upper part, and in front, of the gall-bladder), and by the fact that inflation of the stomach causes a displacement of the tumour slightly to the right. It is thus recognised from kidney and gastric tumours. The chief difficulty, and at times an insurmountable one, is to distinguish the lump from a tumour, hydatid or malignant, of the liver near its free edge. The perfectly smooth contour and the absence of other irregular nodules, and the free range of mobility will generally permit an accurate discrimination to be made.

Hydrops of the gall-bladder results when infection is absent or extremely attenuated. If the inflammation aroused be acute and the infection at all virulent, empyema will result. The clinical conditions associated with the empyema vary greatly in severity, and are in direct proportion to the intensity of the infection. In the more chronic forms the symptoms may be little more acute than in hydrops; in the most acute they are so grave that a fatal result may occur within a few days. In

all cases the bacterium coli commune, with either the staphylococcus pyogenes aureus or albus, is present.

In one case, illustrating the most chronic form of the disease, the patient was a man, aged fifty-eight, who had suffered for twenty years from "indigestion," and fullness and distension of the upper abdomen after meals. Fifteen days before the operation a pain had suddenly been felt in the gall-bladder region. This decreased day by day for several days, and never at any time compelled the patient to seek rest in bed. For the first two days there was a temperature ranging as high as 100°. After the first week a tumour was noticed and was recognised by the medical men as a dilated gall-bladder. This increased steadily in size, and at length was approximately equal to a cocoanut. It was slightly tender on pressure, and after examination the side "felt stiff" for two or three hours. At the operation a large, densely thickened gall-bladder was found full of stones and pus, and a stone was impacted in the cystic duct. The gall-bladder and cystic duct were removed. A rather more severe form is illustrated by the following record:

The patient, a lady of forty-one, had suffered for seventeen years from gall-stone attacks, which were so recognised by her husband, a medical man. Dieting and medical treatment were carried out with alleviation to symptoms, except on about six occasions during seventeen years, when pain, and a rigor or tenderness in the region of the gall-bladder, were noticed. There had never been jaundice. Three weeks before I saw her the gall-bladder had enlarged to the size of a lemon, but had subsequently subsided until it was barely as large as a hen's egg. A

rigor, pain, profound collapse, lasting about four hours, had occurred at the onset of symptoms. On examination, the day before operation, there was marked local tenderness—the pressure sign being readily elicited—and some enlargement of the gall-bladder was recognisable. There was no temperature, no pain, when the patient was resting, and food was taken with zest, though in small quantities. At the operation an hour-glass gall-bladder, distended with pus and stones, was found. The cystic duct was blocked by a stone the size of a marble. The gall-bladder and duct were removed and the patient made a speedy recovery.

In the more severe forms the signs of acute inflammation in the gall-bladder are more evident, and a local peritonitis is clearly present. The gall-bladder is exquisitely tender, and its outline is difficult to perceive, owing to an intense muscular rigidity which protects the inflamed area. There is great pain in the whole hepatic region, which is made worse by the taking of a deep breath or by coughing or stooping. There is generally a marked rise of temperature, to 103° or 104° , and a rigor is commonly observed. In cases of this type the gall-bladder becomes very intimately adherent to surrounding structures, to the colon, the duodenum, or the abdominal wall, and if ulceration be present a fistula may form. In a certain, fortunately small, proportion of cases, rupture of the gall-bladder may occur without the formation of protective adhesions, and the perforation then occurs into the general peritoneal cavity. If the ulceration extend deeply from the gall-bladder into the liver, or into a mass of adhesions, a cavity may form in the substance of the liver, or in the centre of a tough

fibrous covering, and in this cavity, which is a sort of diverticulum of the gall-bladder, the stones, bathed in pus, may lie. These circumstances may all occur with empyema or with acute cholecystitis, without blockage of the cystic duct.

Jaundice is more likely to occur in the acutest forms of empyema than in hydrops or in the less acute forms. This is due either to an extension of inflammation along the cystic duct to the common duct, an acute cholangitis that is, or to a peritoneal inflammation which, by the deposit of lymph, compresses or kinks the common duct.

The following series of cases illustrate the various grades in the intensity of an infection which depends upon the blockage of the cystic duct by a stone:

Case 1.—Miss G., aged fifty-one, seen with Dr. Johnson, of Bawtry, July, 1899. The history was that forty-eight hours before I saw her there was a sudden sharp attack of abdominal pain and vomiting, which was attributed to a dietary indiscretion. Pain had increased, vomiting had been serious, and at the end of twenty-four hours a tense, rounded swelling was felt in the abdomen.

On examining the patient I found a smooth, hard, ovoid swelling at the ninth costal cartilage, which was clearly a distended gall-bladder. It was tender on pressure, and manipulation caused a sense of sickness. I opened the abdomen, found the gall-bladder full of bile-stained fluid, and a stone impacted in the cystic duct. The stone was worked back into the gall-bladder and removed. No other stones were found. The patient made a quick recovery and has since remained perfectly well.

Case 2.—Mrs. S., aged thirty, seen July, 1900, with Dr. Waugh, Skipton. There was impaction of stone in the cystic duct, followed by hydrops of the gall-bladder.

The patient has suffered from pain in the right hypochondriac region for several years; on a few occasions has been jaundiced and the motions have been like "drab paint." Four weeks ago a severe attack of pain, followed by jaundice, which lasted seven days. Soon after the attack subsided a lump was felt beneath the ribs on the right side; the swelling has gradually increased in size, has become exquisitely tender. On several occasions has had severe attacks of vomiting.

The tumour was diagnosed as a distended gall-bladder. On opening the abdomen a large, fully distended gall-bladder, equal in size to a large lemon, was found. The surface was injected, and there were many adhesions to the omentum, stomach, liver, and abdominal wall. These were separated and the larger ones ligatured. The gall-bladder was aspirated, about eight ounces of thin clear mucoid fluid removed, and the gall-bladder then incised. A stone impacted in the cystic duct was gradually pushed backwards into the gall-bladder and removed; it was almost as large as a nutmeg and was solitary. The gall-bladder was drained for eleven days. Recovery was uninterrupted.

Case 3.—Mr. C. B., aged thirty-eight. Sent by Dr. Booth, Grimsby. The patient's first attack of gall-stone colic was five years ago; it was followed by jaundice, which lasted only a few days. Two years ago there was a similar attack, and since this the patient has had some difficulty and pain after an ordinary meal. Three weeks before I saw him a third attack of colic occurred, followed by jaundice lasting one week. During this attack and subsequently he noticed that the motions were pale and the urine high coloured. A tumour formed beneath the right rib margin, and assumed the size and shape of a cocoanut. During the first week it steadily increased, then remained stationary for about a week, and has since very gradually diminished.

I operated April, 1902, and found the gall-bladder much enlarged, and the omentum and stomach a little adherent; on aspiration about seven ounces of thick, dirty-looking bile were removed. A stone equal to a Barcelona nut was found in the cystic duct and six other stones in the gall-bladder. The hepatic and common ducts were free. The stones were removed and the gall-bladder drained for eight days. The wound then healed and the patient has since been in excellent health.

Case 4.—Mrs. T., aged forty-one. Seen March, 1901, with Dr. Wiseman, Leeds. For the last three months has suffered from pain and tenderness on the right side of the abdomen. Sickness has been a troublesome symptom, and wasting a marked feature. The attacks of pain are referred to the right side of the abdomen at about the level of the umbilicus. Four days ago an acute attack closely simulating intestinal obstruction came on. There were vomiting, hiccough, constipation, and marked prostration. A tumour was then found on the right side of the abdomen, almost entirely below the umbilicus and vertical in its longest diameter. The liver edge could be indistinctly felt just above the swelling. The abdomen was opened and the tumour found to be a largely distended gall-bladder containing pus and forty-six stones. A single stone was tightly wedged in the cystic duct. The gall-bladder was deeply congested, and a few omental and colic adhesions were found. The stones were removed and the gall-bladder drained for eleven days. An uninterrupted recovery followed.

(b) **Acute Cholecystitis.**—This in its various forms is the most common variety of inflammation caused by gall-stones. Indeed, many of the symptoms in the slighter attacks of gall-stone disease are due to a mild cholecystitis. When the gall-stone becomes blocked

in the entrance of the cystic duct, an infection speedily follows, effusion takes place into the gall-bladder, and inflammation of its walls speedily follows. Acute cholecystitis is therefore the precursor both of hydrops and of empyema of the gall-bladder. The inflammation may also start at the fundus of the gall-bladder or indeed at any part of the walls. The swelling rapidly spreads over the whole mucosa, and when it reaches the orifice of the cystic duct, the swelling of the mucosa effectually blocks the passage down the duct. In acute cholecystitis the occlusion of the cystic duct may be primary, causing the cholecystitis, or secondary, resulting from the cholecystitis. The block may be due to impacted stone, to swelling of the mucosa, to kink of the cystic duct, or to swelling of the gland which is normally present at the first bend of the duct.

The symptoms of an acute cholecystitis are identical with those caused in the early stage of a "regular" cholelithiasis, save for the fact that the gall-bladder is always enlarged, is palpable, and is tender on pressure. Jaundice is never present unless the inflammation extends down to the cystic duct and affects the mucosa of the common duct. Such an extension is extremely rare. The enlarged gall-bladder is sometimes the seat of acute pain, which may radiate into the chest, back, or abdomen. The side is stiff and sore for several days. The varieties of acute inflammation described are catarrhal, suppurative, and gangrenous. The catarrhal form, and indeed the other forms, may arise in the absence of gall-stones, but in the great majority of instances it is the damage done by a calculus that opens the path of infection.

In acute cholecystitis the symptoms are not seldom those of an acute appendicitis; the signs also are similar, though in the one the upper part, and in the other the lower part, of the abdomen on the right side is affected. Pain is the first symptom; it is sudden in onset and increases rapidly; it is both paroxysmal and continuous. It is felt chiefly over the liver, especially along the liver border, but it may radiate widely in several directions and may even mimic the pain of appendicitis or of subacute perforation of the stomach or duodenum. It is not long before other symptoms of infection occur, nausea and perhaps vomiting, prostration, collapse, marked rigidity, and tenderness in the gall-bladder area. If there is a peritoneal infection of wide extent, the symptoms are more severe than those depicted. In some instances, indeed, they may so closely resemble those of an acute intestinal obstruction as to lead to an operation for that condition; and it is only during the manipulations that it is recognised that the gall-bladder is the cause of the symptoms. The temperature is generally raised to 100° or even higher; the pulse too is rapid and weak. In this, as in all other abdominal conditions, the pulse is the safe guide, and is more to be depended on than the temperature.

The organism found is generally the bacillus coli, but in the suppurative forms the streptococcus pyogenes aureus and albus or staphylococci may be present. The bacillus of Eberth and the pneumococcus are also found.

So long as the inflammation is limited to the mucosa

it does not give rise to acute symptoms, nor does it endanger the life of the patient. Such a condition of infection, however, is produced that subsequent troubles from redisturbance of the stones or a fresh accession of inflammation will almost without exception be found to follow; that is to say, that gall-stones which have once caused cholecystitis will rarely, if ever, become quiescent.

In many cases the inflammation, even when apparently slight in character, as estimated by the clinical disturbance, has been of sufficient severity to penetrate to the serous coat. A pericholecystitis is caused, a local peritonitis involving the serous coat of the gall-bladder and the immediately adjacent structures. The formation of a plastic lymph, which in recent cases can be peeled off in thin layers, is the result, and this at the last leads to the firm adhesions which may be so troublesome a feature in any operative procedure. Adhesions so formed may in certain infrequent cases persist long after the stone or stones which have caused them have passed, and they may cause symptoms which are not to be distinguished from those due to the irritation of gall-stones.

When the acute inflammation has subsided, a thickening of the gall-bladder is left. There is never a restitution to the normal; a chronic cholecystitis remains. When a fresh infection occurs, the chronic cholecystitis becomes acute, and this again subsides. There is an alternation then between acute and chronic cholecystitis to the serious and increasing impairment of the gall-bladder.

When the inflammation spreads to the serous coat, a local peritonitis, easily recognisable on clinical examination, speedily develops. The condition then is only a degree less acute than that present in acute phlegmonous cholecystitis, to be presently described. The signs and the symptoms are those of an acute localised peritoneal infection. As a rule, the rigidity, tenderness, and pain are limited to an area immediately below the free edge of the liver. The condition is one which demands early surgical treatment. Körte has related 17 cases of acute cholecystitis upon which he operated. Stones were present in 16 cases, absent in 1, but in this a stone had probably been present a little earlier. Of these cases there were 7 in which the stones had been absolutely latent, there were 5 in which symptoms were present but had led to an erroneous diagnosis of stomach or kidney disease; in the remaining 4 gall-stones had been diagnosed. In 6 cases cholecystotomy and drainage, in 5 cholecystectomy and tamponage, in 6 cholecystectomy and drainage of the common duct were practised.

There is, however, a much more serious form of inflammation of the gall-bladder than these—phlegmonous cholecystitis. This disease was first described by Courvoisier in his memorable paper in 1890. He collected 7 cases, and described them as “acute progressive empyema of the gall-bladder.” The following cases which were under my care illustrate the gravity of the condition:

Case 1.—Phlegmonous Cholecystitis: Sloughing and Perforation of Gall-bladder.—M. A., aged forty-six; male.

Patient seen with Dr. Erskine Stuart, Batley. Had been perfectly well up to December 31, 1900. On that day he had a sharp attack of pain in the right hypochondriac region about an hour after his evening meal. He felt sick and cold, vomited several times, and could only obtain ease by doubling himself over the back of a chair. He was given a large dose of opium and put to bed. The next day he was slightly jaundiced; the day following more so, and the jaundice has persisted. Pain in the right hypochondrium has been constant—relief had only been obtained by opium administrations.

On examination, January 11, 1901, the patient was found moderately jaundiced and looking ill. The abdomen was full and prominent; the whole right hypochondriac region was hard, strongly resisting, tender on pressure. The muscular protection was so effective that no deep examination was possible. A diagnosis of cholangitis and cholecystitis, depending possibly upon calculus, was made. The rigidity and tenderness were supposed to be due to a localised peritonitis, possibly dependent upon distension of the gall-bladder as a result of obstruction of the cystic duct.

The abdomen was opened on January 12th by an incision through the right rectus muscle. On opening the peritoneum bile-stained liquid with flocculent masses of lymph flowed from the wound. At the least three pints of fluid were removed. A collection was found between the liver and the diaphragm, the fluid there being thick and semi-purulent. An examination of the gall-bladder disclosed the cause of the condition. The gall-bladder was thickly coated with lymph, was deep-purple in colour, and shewed a sloughing opening on its surface from which bile-tinged fluid was oozing. The opening was about one and one-fourth inches in diameter; its edges were ragged and a little thickened. In the

gall-bladder seven stones were found; an eighth, the largest, was discovered later in the upper part of the renal pouch, partly buried in lymph. The cavity was cleaned up as well as possible, the gall-bladder opening trimmed, and a drainage-tube secured in it; the sub-phrenic abscess was separately drained, and a tube was also passed in through a stab wound in the loin.

The patient, whose condition was bad before the operation, died, gradually declining in forty-eight hours.

*Case 2.—Gangrene and Perforation of the Gall-bladder.—*W. D., male, aged fifty-two. Admitted Sept. 9, 1902, with the following history:

The patient has suffered from indigestion, biliousness, and discomfort after food for twenty-five years, when he had typhoid fever; the vomiting, first observed five years later, was at first infrequent and copious. Eight years ago his condition became worse. He had constant severe pain after food, frequent vomiting, often twice daily, and lost over a stone in weight in about three months. He improved a little during the following year but has since steadily lost health and strength. Six months ago was seen by an eminent physician who diagnosed "cancer of the stomach." His loss of flesh has latterly been extreme, he is now very sallow, wasted, and feeble. The stomach reaches midway between umbilicus and pubes, can be seen contracting on distension. Free HCl present in small quantity. At the operation, the condition found was a dilated and somewhat hypertrophied stomach. A large thick mass in the duodenum, involving the pancreas, was found, and was thought to be malignant. The stomach was much dilated and its coats were thickened. Posterior gastro-enterostomy was performed and all went well for twenty-eight days. At

the end of that time the patient became suddenly very ill. Collapse and the vomiting of bile were the chief features and jaundice quickly followed. The abdomen was distended and exquisitely tender over the hepatic area. The abdomen was re-opened and a gangrenous and perforated gall-bladder was found. Bile was seen escaping from the openings in the gall-bladder. The gall-bladder and the peritoneum were drained, but the patient died in a few hours. It was found that the malignant growth had involved the pancreas along its upper and right margin, and the hepatic artery was imbedded in the growth.

This case is instructive as only three small gall-stones were found either in the gall-bladder or the ducts, and the patency of the ducts during life was shewn by the vomiting of bile. The interference with the blood supply was undoubtedly the cause of the gangrene.

The condition is clearly analogous to the acute phlegmonous appendicitis which is occasionally seen; both are conditions in which the bacterial virulence is so excessive that a complete destruction of the appendix or gall-bladder is accomplished before the peritoneum has had the time to protect itself by the out-pouring of serum or lymph.

The symptoms of phlegmonous cholecystitis are of the gravest type. There is a sudden onset of very acute pain in the right hypochondrium. This may be so profound as to cause collapse, faintness, and great prostration. The pain comes generally on without obvious cause, but in not a few instances it has been attributed to the taking of an unduly heavy meal. The constitutional

disturbance is alarming. The pulse is rapid, feeble, almost running; the hands and, indeed, the body surfaces generally are cold, clammy, covered with sweat; there is sometimes a rigor, but always an elevation of temperature during the first few hours. The local signs are seen early, and are those of a peritonitis, limited at first to the gall-bladder region, but later becoming generalised.

(*c and d*) **Sclerosis and calcification of the gall-bladder** occur at a late stage of the disease and are the results of a dense inflammatory deposit in the walls of the viscus. The symptoms are those of chronic cholecystitis, and have already been detailed.

PRESSURE EFFECTS OF STONE IN THE CYSTIC DUCTS.

In addition to all these conditions a stone impacted in the cystic duct may, by its pressure upon the common duct, portal vein, or duodenum, give rise to symptoms which tempt the surgeon to an erroneous diagnosis. The pressure upon the common duct causes cholangitis, and the symptoms of a stone in the duct are portrayed. Pressure upon the portal vein causes thrombosis and ascites. If both the common duct and the portal vein are compressed, there will be jaundice and ascites, and a diagnosis of malignant disease will be suggested. Pressure upon the duodenum, as in two cases recorded by Mikulicz, has caused the symptoms of gastric dilatation.

The following illustrative examples may be quoted. In a discussion before the Chicago Surgical Society

(Annals of Surgery, vol. 35, p. 666) Dr. McArthur gave the following account of a case:

Last July he had occasion to make, as a last resort, an operation upon a patient in the practice of Dr. Favill, who had been seen by von Jakseh in Prague, and who had sent him immediately home to undoubtedly die, as he said, from malignant disease of the liver, with no thought of operation. When the patient reached Chicago, he was seen by Dr. Fenger, the diagnosis of malignant disease of the liver confirmed, and "hands off" the verdict. This man was in that terrible condition which obtains after six months' persistent jaundice, and, in addition to an enlarged and hardened liver, he had extreme ascites. On reviewing the history with Dr. Billings and Dr. Favill, he suggested that, as a *dernier ressort*, at least an exploratory laparotomy be made; if a stone be found, to give the patient relief; and if it were possible, to make a cholecystenterostomy to do that, and relieve the jaundice. In the face of fatal issue, which the patient was told might easily and quickly ensue because of the dangers of hæmorrhage and of his great emaciation, patient requested an operation. A quick exploration of the gall-bladder was made. The gall-bladder was found packed with stones, with one large, barrel-shaped stone plugging the cystic duct. The patient died on the third day after the operation. Nothing was seen of malignant character at time of operation except nodule on liver edge. A partial post-mortem examination revealed on the margin of the liver, at a point close to the gall-bladder, a small hazelnut-sized tumour, which was removed for examination, and was pronounced an adenoma; but no malignant disease of the liver, the duodenum, the stomach, or pancreas was seen.

A similar case to this was under the care of Dr. Moore of Minneapolis. Jaundice and ascites were present; a stone was found impacted in the cystic duct, compressing the common duct and the portal vein. It was removed and the patient recovered.

For the notes of the following case I am indebted to Dr. Barrs (the patient was under the care of Mr. Littlewood, and subsequently of Dr. Barrs in the Leeds Infirmary):

Female, aged fifty-nine. November 18, 1903. Patient was well up to six years ago, when present illness began; always temperate, no venereal disease, has had 14 children; well-built, fairly stout woman. Illness began quite suddenly with violent "tearing" pain in upper part of right side of "body." She was doubled up, vomited and sweated profusely. The attack lasted about twelve hours, and she was yellow for three weeks after. Her motions were white and her urine dark, and she was in bed one week and attended by a doctor. Except for slight pain in her right side, she got quite well.

Two years ago she had a severe attack of pain and again one year ago, but was not jaundiced so far as she knows.

In September, 1903, she says she first noticed "her body was swollen" and that she was becoming "yellow in the eyes"; then she noticed that her urine was dark coloured (just as it had been in her severe jaundice attack six years before) and "smelled badly"; she became constipated and her stools were white. She went to a doctor to have her urine examined and was given pills which relieved her constipation. About the middle of September she felt cold and chilly and went to bed, and for two or three weeks vomited most of her food. Her appetite was bad and she was very thirsty; the distension of the "body"

increased and the legs swelled a little. On October 20th, the doctor drew off from the peritoneal cavity 11 pints of dark fluid. She rapidly filled again and was admitted to Leeds General Infirmary on October 23d.

On examination, marked jaundice; stools *not* clay-coloured; urine, sp. gr. 1012, bile present, no albumin, no sugar, much ascites with usual signs, but the liver is palpable through it. Liver reaches one to two inches below costal margin, edge sharp, regular, not tender, moves freely on respiration, absolute dulness reaches sixth rib in mid-axillary line. Below margin of liver, opposite tenth right costal cartilage, the hand "dips" through fluid on to a mobile, rounded lump, probably gall-bladder.

Her general condition was fair; no distended veins were seen; all other organs are normal.

November 16th: Abdomen tapped and 9½ pints of dark, bilious, transparent fluid withdrawn.

November 17th: Not quite so well, feels weaker, fluid accumulating somewhat rapidly. Five P. M., much worse, pain in abdomen, more fluid in peritoneal cavity, pulse still good. Hot fomentations applied tightly to abdomen, and calcium chloride, gr. xx, given two hourly, because hæmatemesis feared; some vomiting, some dyspnœa.

Ten P. M., still sinking rapidly, fluid now fills peritoneal cavity, pulse good, anxious expression, probably bleeding into peritoneal cavity.

November 18th: 4.15 A.M., death.

P. M. November 18th: Body jaundiced, abdomen distended with fluid, peritoneal cavity full of bloody fluid and blood clots amounting to 6 pints; no place could be found except the recent wound through which tapping had been done from which the hæmatemesis had come, although the whole peritoneal surface looked very vascular. A clot was adherent to puncture wound on peritoneum. Liver generally enlarged, bile-stained surface finely granular, substance distinctly tough (early cirrhosis?). Gall-

bladder sausage-shaped, $4\frac{1}{2}$ inches long, 2 inches broad, containing multitude of minute stones in clear mucus. Hepatic ducts markedly dilated. Half stone about size of a medium-sized Barcelona nut. Common bile-duct is dilated, contained a few minute stones and bile-stained mucus. The stone in the cystic duct pressed against the common duct, almost occluding it, the duct being dilated above and natural below the point of pressure. The stone in the cystic duct also exerted pressure upon the portal

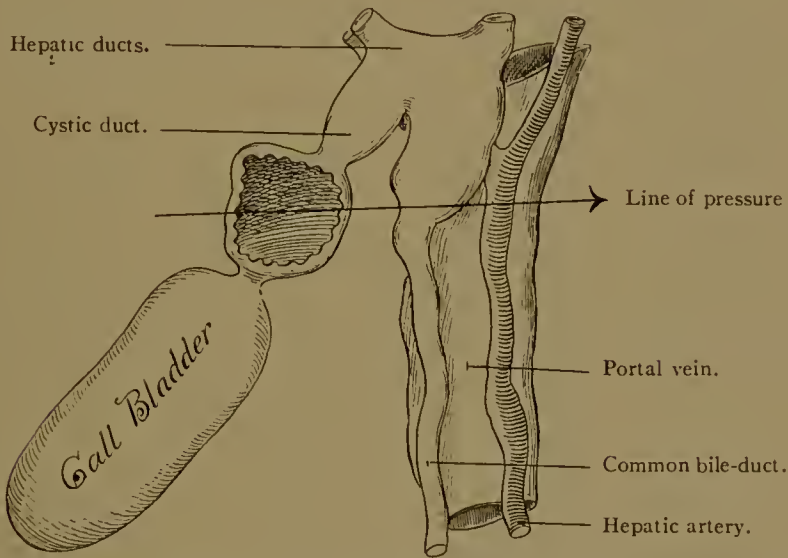


FIG. 42. —Drawing made by Mr. L. R. Braithwaite, who performed the postmortem examination.

vein, there being slight peritonitic adhesions between them at this point, although the portal vein was readily patent to a probe passed from below. A probe passed easily from junction of cystic with common bile-duct along into the duodenum.

Pancreas.—Markedly large. Substance unusually hard and gritty. Head very hard and large. Substance on section appears normal.

Microscopical Examination (Dr. Forsyth): "Pancreas shows an early stage of chronic pancreatitis."

174. Special Symptoms in Gall-stone Disease

Courvoisier records four cases in which the portal vein contained a gall-stone which had ulcerated into it from the gall-bladder or ducts.

(C) STONES IN THE HEPATIC DUCT.

Stones in the hepatic duct are less commonly seen than stones in any other part of the bile passages. As a rule, when there are stones in the hepatic duct there are others in the common duct or in the gall-bladder. This, however, is not universally the case.

In 59 cases collected by Courvoisier, in 56 stones were present in other parts of the bile passages. In 51, in which distinct mention is made of the condition of the common duct, there were stones therein in 45. Small stones composed of bilirubin calcium are not infrequently found in the hepatic duct when this is explored after the removal of a stone from the common duct. Such small calculi are black or dark brown in colour and are readily compressed to a fine powder by the pressure of the fingers.

Michaux (Bull. Soc. Chir., 1894) comments upon the extreme infrequency of stone in the hepatic duct. In a search through the Bull. de la Soc. de Chir. since its foundation, in 1826, only eight cases of stone in this duct were found recorded. In almost all the cases a large calculus was also found in the common duct. Michaux expressed the opinion that hepatic stone was always secondary to stone in other parts of the biliary passages.

Stones may be formed, though this is probably very rare, in the hepatic duct, and there remain stationary,

gradually enlarging by added deposits from the bile stream, or they may, and in the very great majority of cases they doubtless do, pass down from the gall-bladder along the cystic duct and turn upwards into the wider hepatic duct, whether the common duct be blocked or free. A single stone may be found; more commonly there are many. When solitary, the stone is generally of the size of a nutmeg, or even larger.

The symptoms due to a stone or stones in the hepatic duct are not separable from those due to blocking of the common duct.

The following is the record of a case which was under my care:

Case 8.—Mrs. T. B., aged 39. Seen with Dr. Sproulle, Mirfield. Three years ago she had an attack of epigastric pain and vomiting, followed by slight jaundice—a typical attack of biliary colic. Since then she has had nine similar but progressively more severe attacks. Nine weeks ago an extremely severe attack. Pain has continued all the time, and jaundice, though varying slightly, has always been pronounced. The motions during this period have been light coloured, the urine thick and scanty. Pain is constant, but at times an acute paroxysm occurs. Has lost flesh rapidly during the last two months, and has been eating little, owing to pain and heaviness after even light diet, and vomiting.

Operation, December 7, 1900.—Eighty-seven gall-stones were removed, mostly from the hepatic and common ducts. A few lay in the gall-bladder, but both hepatic ducts and the whole length of the common duct were filled with tightly packed stones. These were removed through an incision in the common duct, which was afterwards sewn up. A stone was found tightly impacted in the ampulla

of Vater, and the duodenum had to be opened in order to remove it.

The patient had severe hæmatemesis after the operation and died on the third day.

Stones in the hepatic duct are liable to be overlooked. I have on several occasions found well-formed stones unexpectedly in the hepatic duct, or in one of the branches, when engaged in removing stones from the common duct. In all, the stones were easily milked downwards and removed through the common duct incision. In some cases, however, the separate opening and draining of the hepatic may be needed.

When infective or suppurative cholangitis occurs, the outlook is desperate indeed. Naunyn relates a case from the practice of Kussmaul in which, after cholelithiasis of many years' duration and three weeks of fever with jaundice and rigors, the patient succumbed to marasmus. At the autopsy the hepatic duct was blocked by a concretion. Its branches and the intra-hepatic ducts were blocked throughout. They formed a system of mutually communicating sinuous cavities, varying from the size of a millet seed to that of a cherry stone. Within the liver, near its hilus, these cavities were so abundant that the liver "resembled a bath sponge with larger and smaller perforations." These cavities were filled with bile-stained pus, and their walls consisted of a distinct membrane with a ragged surface; the liver tissue was dry and jaundiced.

When suppuration behind a stone in the hepatic duct has extended into the liver, the condition described by Leonard Rogers (Brit. Med. Journ., vol. 2, 1903, p. 706) as "biliary abscess" results. There is a universal suppu-



FIG. 43.—Dilated hepatic duct; ascending suppurative hepatitis. The gall-bladder is greatly contracted, and its cystic duct leads into a cavity two inches across, produced by the dilatation of the hepatic duct, which contained bile and pus, with many small black calculi. The common bile-duct, also communicating with this cavity, is somewhat dilated and contains a gall-stone the size of a cherry, impacted half an inch from the papilla. Scattered through the liver and beneath the capsule are many small ragged abscess-cavities. From a woman, aged thirty, admitted for jaundice of fourteen days' duration. Five months previously, after a severe attack of enteric fever, a swelling was noticed in the region of the gall-bladder, but this gradually disappeared. On admission the liver was uniformly enlarged; pyrexia was present; she also suffered from rigors. After death, a fortnight later, the liver was found to weigh 110 ounces, and the peritoneal cavity contained much bile-stained, purulent lymph (Guy's Hospital Museum, No. 1418).

rative cholangitis, the ducts within the liver being greatly dilated and filled with pus. There may be nothing which, even on the closest scrutiny, suggests a diagnosis of gall-stone trouble; there may never have been pain, vomiting, colic, or jaundice. In other cases, however, a history suggesting the impaction of a stone in the common duct will have been obtained. Leonard Rogers attaches great significance to a group of symptoms which was present in more than half the cases collected by him.

“It consists of a complete obstructive jaundice, which is always present in the earlier stages of the disease, followed by the reappearance of bile in the stools in often small quantities and a decrease in the jaundice, accompanied by an aggravation of the general symptoms with rigors and hectic condition, instead of the amelioration naturally expected to ensue on the partial removal of the complete obstruction of the bile-ducts. This improvement in the jaundice and reappearance of bile in the intestine, together with increasingly severe general symptoms, is due to softening and distension of the wall of the ducts by suppuration occurring within them above the obstruction leading to loosening of the impacted stone, which, in turn, allows of the escape of a little of the bile and pus into the bowel past the stone.”

He records the following case:

The patient was in the Forest Department (Calcutta), and he came in on April 6, 1902, for the treatment of enlarged liver and a history of occasional attacks of ague and repeated attacks of jaundice, preceded by severe pain, the last of which occurred three weeks before admission. The liver dulness extended from the fifth rib to six inches

below the costal margin. Spleen not enlarged; heart and lungs normal; pulse 48; slight jaundice; temperature normal. From April 13th to 17th he suffered from intermittent fever and was treated with quinine. On the 22d he had a rigor, the temperature rising to 104° , falling to 101° the next morning, when I examined the blood at the request of the physician under whom the patient was at that time, as liver abscess was suspected. I found no leucocytosis, but, on the contrary, they were below the normal, with a large proportion of large mononuclears, and further search revealed malignant tertian parasites, and quinine treatment was resumed; and with the exception of a slight rise on the 27th and ague on May 4th and 7th no more fever occurred; the jaundice improved and he left the hospital on May 18th, the case at this period having been one of biliary colic, accompanied by malarial fever.

On December 18, 1902, he returned to the hospital and came under my care. Ill since 7th in bed. Has passed several gall-stones since the 15th, which he brought with him, the largest being about $\frac{3}{4}$ inch in diameter. The liver dulness extended from the fourth space to three inches, and much pain of a colicky nature, requiring morphine. Temperature from 100° to 102° , with profuse perspiration. The fever continued, and on December 22d he coughed up a quantity of viscid, frothy mucus. Temperature of a hectic type, continued rising to 103° and 104° in the evening. The vocal fremitus was slightly diminished, but there was only partial loss of resonance at the right base. I diagnosed suppuration in the bile-ducts in the liver, and advised operation for the purpose of draining the ducts and removing any gall-stones. After a consultation this was agreed to. On the morning of the 25th he coughed up a small quantity of pus, but in view of the case mentioned above, in which a fatal termination ensued in an abscess of this kind, in spite of the opening through the

lung, and having certain knowledge of gall-stones having been passed, it was decided to proceed with the operation as previously arranged, Captain H. Mackin, I. M. S., kindly helping me.

Operation.—An incision was made in the right linea semilunaris, with its centre over the lower edge of the liver. The gall-bladder was completely hidden beneath the edge of the liver, but its fundus was reached and opened, and a number of small gall-stones were extracted. On now passing the finger along the bile-ducts beneath the liver, a large mass of gall-stones were felt deep under the liver, which could only just be reached. The wound was now enlarged upwards and downwards, and a transverse incision made across to the middle line, so as to enable the lower edge of the greatly enlarged liver to be turned up. The mass of stones in the right hepatic duct could now be reached and opened, and with very considerable difficulty a mass of large gall-stones some three inches in length and over an inch in diameter in places, were removed, some of which were well within the liver substance. As it was quite impossible at such a depth to bring the opening in the duct to the surface, and as the patient was in a low state, a glass drainage-tube was inserted and gauze carefully packed around it, and the wound united around the tube. The patient suffered severely from shock, rallied somewhat in the afternoon, but was much troubled by coughing up mucus. At 10 in the evening he was easier and coughing up mucus more easily. However, he never fully rallied from the shock of the prolonged operation and died at 5.30 A. M.

Necropsy.—The same morning the body was examined. There were already good adhesions around the gauze packing and no trace of leakage of discharge into the peritoneal cavity. The liver was removed with the stomach and duodenum and right lung altogether. Only one small gall-stone in the depth of the liver in the right hepatic

duct was found, which was much smaller than some of those removed at the operation, so would easily have escaped through the opening made in the duct, and would doubtless have escaped through the wound, although too deep in the liver to be removed at the operation. Behind this stone the bile-ducts were much dilated and full of pus in a limited portion of the upper posterior portion of the right lobe of the liver. This tracking abscess had opened posteriorly by the side of the inferior vena cava, and travelled up through the diaphragm and the base of the right lung into the inferior bronchi. The common bile-duct was dilated and its opening into the duodenum was large and free.

In rare instances the duct behind the stone may rupture, as in the following case recorded, with comments, by John Freeland, M.R.C.S. (*Lancet*, May 6, 1882):

Maria J., a black, aged sixty-five, who has been for many years troubled with intermittent fever, followed by a regular train of symptoms, commencing with vomiting, colicky pains, and tenderness of the abdomen, and ending with jaundice, more or less severe, applied to me during one of these attacks, stating that, in addition to her generally distressing symptoms, she was now seized with violent and excruciating pain in the stomach and chest, and that she could retain nothing whatever—water, nourishment, or medicines being immediately rejected with greatly increased suffering.

On examination I found her skin hot and dry, pulse hurried, abdomen fuller than natural, and in some parts painful on pressure. She says she has been taking the medicines I generally prescribed during these seizures, but has not obtained the relief from them she usually did on former occasions, and was quite sure, from the pain

and excessive prostration she now felt, that there was some other complaint added to her old disease. I immediately prescribed fifteen drops of tincture of opium, with a little sulphuric ether, and applied a large warm linseed poultice over the stomach and upper part of the abdomen. This seemed to have a very good effect, for the pain was completely subdued after a second dose, and the tenderness of the abdomen, which was so evident at the time of my first examination, was now almost entirely gone; the warmth of skin, although somewhat subdued, continued, however; and as there was now a feeling of headache and nausea, which prevented my patient from expressing herself as much relieved, as I expected she would have been after having suffered so intensely some hours before, I ordered a mixture of carbonate of soda and nux vomica in small doses, and desired her to report at once in case the pain should return. During the next night she was suddenly seized again with acute pain, but was as readily and easily relieved by the opiate, ether, and poultice, as in the previous instance. Her relief, however, was of short duration, for the pain soon returned with increased severity, and was now accompanied with a somewhat tympanitic and extremely tender abdomen. I at once ordered pills of calomel and opium, to be administered every second hour, and the poultice to be continued, with the addition of spirits of turpentine freely sprinkled over it. On my next visit, in about six hours afterwards, I found the extremities cold, pulse 120 and small, and the body generally covered with a clammy sweat; the pain in the abdomen had ceased, but the vomiting returned at intervals, with great depression, until she died in about eight hours afterwards.

On examination of the body almost immediately after death, the cavity of the abdomen was found literally filled with blood and bile, the intestines gangrenous in spots,

and here and there highly inflamed and congested; the peritoneum one mass of inflammatory deposit and adhesions, the liver and gall-bladder healthy; the latter appeared, however, smaller than natural, and was *entirely empty*, and the spleen, which was of a bright orange tint, was so deeply stained with bile that even when removed, washed, and broken up in pieces, the bright colour remained and appeared to be so intimately mixed up in its stricture that it was quite impossible to lessen it. The hepatic duct was found lacerated, and the opening in this through which the bile had escaped appeared but recently formed, but the calibre of the duct was much larger and its length greater than usual, and in some places distended into pouches or bags which contained gall-stones varying in size from a pea to a strawberry. In one of these pouches or bags a most remarkable appearance presented itself in the form of a slit or opening, which was fully occupied and occluded by the point or apex of one of these stones. On displacing and replacing the stone in its position (which was most readily effected by the mere disturbance of the parts), I discovered that the slit which it had occupied was as completely and naturally formed as if it had been the normal state of the duct, the edges being firm, smooth, and slightly everted; and although this stone must at some time or another have caused ulceration by its pressure and given rise to grave symptoms, there is no doubt in my mind that it afterwards acted as a plug, and so effectually sealed the aperture in the duct (so long as it remained *in situ*) that no bile escaped into the cavity of the abdomen except at times, and in such minute quantities as only to give rise to those slight attacks and symptoms which I already mentioned as having been of frequent occurrence during the usual intermittent fevers which my patient more or less annually passed through.

Now it is evident, I think, that the second or recent rupture in the duct, which was quite patulous and surrounded with coagula, was the immediate cause of death, and that the first or older opening existed for years and had been nearly always occupied and closed by the presence of the gall-stone which only occasionally allowed the bile to escape when from some particular exertion or vomiting it became temporarily displaced.

(D) STONE IN THE COMMON DUCT.

Obstruction of the common duct by a gall-stone or several stones may be complete or incomplete. A single stone may be so tightly wedged in the duct that no drop of bile can pass by it, or, on the other hand, it may fit so loosely that bile may, from time to time, flow past it readily. Courvoisier, in 123 cases, found that the position of the stone or stones blocking the common duct was as follows:

In 17 cases at the commencement of the duct.

In 19 cases in the middle of the duct.

In 20 cases near the duodenum (retroduodenal portion).

In 41 cases at the ampulla.

In 26 cases the whole length of the duct was blocked.

In cases recorded by Cruveilhier and Frerichs, the whole length of the bile passages, including all the intra-hepatic ducts, was blocked by an infinite number of fine stones and sand.

1. **Complete occlusion of the duct** is rare. It results more often from growth or stricture in the duct or compression of the duct from without than from stone.



FIG. 44.—Dilatation of the intra-hepatic ducts (Cruveilhier).

A stone producing complete blockage of the duct may lie wholly in the common duct or may be extruded into the lumen from the cystic duct. In the latter condition there is always an immense thickening of the ducts, the wall of the cystic duct in one specimen in my possession measuring nearly an inch in thickness. In all cases where the block is complete the bile pent up behind the stone becomes gradually absorbed and the hepatic ducts become filled with clear, sticky mucus, and are everywhere greatly dilated.

The chief, and often the sole, symptom of complete occlusion of the common duct is deep and unvarying jaundice. Pain may be present in the earliest stages, but it is rarely or never severe and speedily disappears. There is no distension of the gall-bladder, and the signs and symptoms of septic infection, which are such constant features of partial occlusion of the common duct, are entirely absent. It is often a matter of the greatest difficulty to distinguish this form of disease clinically from malignant disease of the ducts or of the head of the pancreas. The early history of pain and colic and the absence of enlargement of the gall-bladder are the most helpful points.

2. **Partial Occlusion of the Duct.**—In the very great majority of cases of obstruction of the common duct by stone the block is only a partial and an intermittent one. When the stone has become fixed, a dilatation of the duct behind the obstruction always occurs. In this dilated duct the stone is free to move. It then forms a ball-valve, as was pointed out by Fenger, at times blocking the duct absolutely, at other times allowing bile to pass

it unimpeded. A ball-valve stone may be found at any part of the duct, but is more commonly found in the ampulla of Vater. If one stone is found to be blocking the duct, other stones will often be discovered. Indeed, obstruction of the common duct is far more often due to many stones than to one. If a stone be found in the first portion of the duct, another may be felt in the ampulla, or the whole length of the duct even may be tightly packed with a multitude of large and small calculi. In other cases stones may be found in the common duct and in the hepatic ducts. No operation can be considered as complete which does not include a very careful examination of other parts of the bile-duct than that in which a large, apparently single stone is found. If possible, an exploration of the duct should be effected with the finger rather than with a spoon or probe. In this way only can it be made certain that the ducts are clear.

The statement that it is the rule to find multiple calculi in the duct, rather than a single stone, is at variance with the statistics of Courvoisier, and almost all other authorities. In the cases that come to the care of a surgeon there can be no doubt whatever of its truth.

As a rule, the lower down in the duct a calculus is found, the smaller is it. Those blocked in the ampulla are approximately the size of a split pea. Those in the upper part of the duct may be as large as a nutmeg.

The ducts behind a calculus are generally dilated to a moderate degree: to a degree almost always that will permit of the forefinger being passed along them. In some cases the dilatation may be phenomenal, and in



FIG 45.—Biliary obstruction; cholecystenterostomy. The common bile-duct was occluded by a black calculus three-fourths of an inch in diameter, and reaching to within an inch of the papilla. The stone shews a bifurcation corresponding to the junction of the cystic with the main hepatic duct, both of which are thus partially obstructed. The gall-bladder and cystic duct are both dilated, as also the hepatic ducts throughout the liver. Just beyond the line of suture in the small intestine is seen a perforation (red rod). From a man, aged forty-one, who was admitted for enlargement of the liver and spleen, with jaundice, from occasional attacks of which he had suffered for fourteen years. On exploration it was found impossible to remove gall-stones. An anastomosis was established between the fundus of the gall-bladder and the jejunum. After death, general suppurative peritonitis was found. The left pleural cavity contained some sero-purulent fluid; the spleen weighed 53 ounces (Guy's Hospital Museum, No. 1422).

more than one recorded case the tumour formed has been recognised on palpation of the abdomen and has been mistaken for a dilated gall-bladder. In one case (Guy's Hospital Museum, No. 1419) the dilated common duct had formed a thick-walled cyst six inches in diameter. The obstruction was valvular. Terrier has recorded three cases in which a dilated duct was mistaken for a pancreatic cyst, a hydatid of the liver, and a distended gall-bladder, respectively. In many cases the duct beyond the impacted stone is dilated also, but it may be found narrowed, or even, it is said, quite obliterated. The wall of the dilated duct consists almost entirely of fibrous tissue, the mucosa being thin and atrophied. The fluid contained within the duct is always deeply tinged with bile, and in fact consists of bile with an added quantity of mucus. In accordance with Courvoisier's observation, it is now generally recognised that in calculus obstruction to the common duct there is rarely any distension of the gall-bladder. On the contrary, the gall-bladder is found shrivelled, thickened, and embedded deeply in dense adhesions, in the great majority of cases.

The symptoms of stone in the common duct are sometimes trivial and inconspicuous, and indeed are at times entirely absent. I have twice found, during the performance of cholecystotomy, that stones were present in the common duct when symptoms were wholly lacking. If the stone is small, or fits loosely in the duct, there may be neither obstruction nor cholangitis, and the stone, therefore, may never attract clinical recognition.

The symptoms are due, in part, to the mechanical

impediment in the duct; in part, to the cholangitis which the stones excite.

Pain is present only at times. It comes, as a rule, in attacks, which vary much in severity. The pain is dull and aching, with, especially in the beginning of the attack, spasmodic outbursts. As a rule, the pain is accompanied by a rigor; the temperature runs rapidly up to 102° , 103° , or 104° ; there are shivering and collapse, followed by sweating, and in the succeeding hours it is noticed that the jaundice, which is persistent, has deepened much in tinge. In the intervals between such attacks as these the patient suffers little or not at all. There is neither pain nor tenderness over the liver, and the jaundice grows gradually paler. Jaundice, which was described by Courvoisier as the "cardinal symptom" of common duct obstruction, never disappears, though in very old-standing cases the patients may say that they are free from jaundice, when there is still an obvious tinge of yellow in the conjunctivæ and in the skin. In one patient, a lady, who had suffered from these ague-like paroxysms for nine years, the skin was said to be "sallow" normally, and the suggestion that she was jaundiced to a slight degree met with no confirmation. It was only after the removal of one large and several stones from the common duct that the patient became convinced, as her skin gradually whitened, that the sallowness was due to jaundice from which she had never been free through all the nine years. Many patients notice that the jaundice varies during the course of the day, being lighter in the morning and becoming deeper towards night.

I have, on two occasions, found stones in the common duct when no symptoms were present. Kehr has said that jaundice is absent in one-third of his cases of stone in the hepatic and common ducts, an experience that is almost certainly fallacious. In over one hundred con-

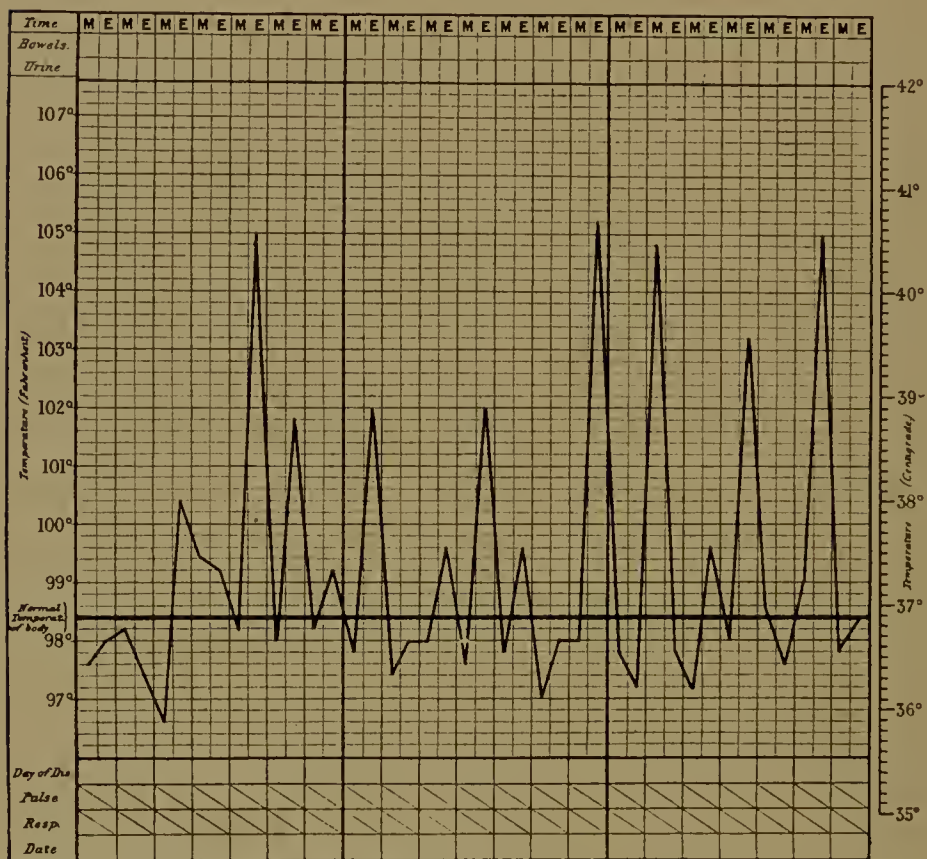


FIG. 46.—The "steeple" chart in a case of stone in the common duct.

secutive operations for gall-stones I have never failed to examine with scrupulous care the whole length of the hepatic and common ducts, and the two instances mentioned are the only ones I have met with.

The temperature angle in an attack is of the characteristic "steeple" form—there is a rapid rise and a rapid

fall to the normal in each attack. Temperature elevation is much more often present in common duct obstruction when a stone is the obstructing agent than when growth or any other form of blockage exists.

Courvoisier, in his analysis of recorded cases, found fever in 25 per cent. of the cases of occlusion from stone, and in only 10 per cent. of the cases of occlusion due to other causes. The former estimate seems to me to be considerably below the truth. If a case of common duct obstruction be observed for a period of two or three weeks, there will, with few exceptions, be found some abrupt elevation of temperature coinciding with the pain, and attacks of shivering and subsequent sweating, not of sufficient gravity to be considered as rigors, will occur.

During an attack, and for some hours after, there may be a slight enlargement of the liver, and the liver everywhere is tender to the touch.

In chronic obstruction of the common duct the liver is always enlarged in the earlier stages; its increase in size may indeed be considerable. The liver may reach the umbilicus, or even descend beyond it. In each attack, when a rigor and an elevation of temperature, followed by a deepening of the jaundice, occur, an increase in the size of the liver may be observed, and the organ on handling is found to be tender. In the latter stages the liver decreases slowly in size, and at the last may be even smaller than the normal. According to Mongour, the shrinkage of the liver is the most important sign of the degeneration of the hepatic cells.

The condition of the stools and of the urine varies from time to time. As a rule, some bile passes always into the

intestine, so that the motions are a deep buff in colour. After an attack there is obvious evidence, both in the fæces and in the urine, that less bile is getting access to the duodenum. The variations are, however, much more readily recognised in the stools than in the urine. The persistent presence of urobilin in the urine is held by many observers to indicate the onset and the continuance of a process damaging to the hepatic cells. In many cases an enlargement of the spleen is noticed, more especially after an attack and for some days subsequently.

The gastric disturbances noticed in cases of gall-stone impaction vary within very wide limits. There may be nothing more than a sense of uneasiness in the epigastrium and distension after food, for which there is often a distaste, or, on the other hand, there may be severe vomiting during and subsequent to the attack and a feeling of profound nausea. Itching of the skin is almost constant, as in all forms of jaundice, and symptoms of boils may at times be noticed.

One of the most marked and characteristic symptoms of obstruction of the common duct by stone is loss of weight. A loss of two, three, or four stone is not infrequently recorded. The loss is both rapid and considerable, and after a successful operation is very speedily regained. This loss of weight was ascribed by Fenger to "intermittent, frequent, ptomaine intoxication,—that is bile-absorption,—as well as to disturbed digestion." It is most important that this symptom should be recognised as a frequent and striking manifestation of stone in the common duct, for the haggard,

wasted, often emaciated appearance of the patient may strongly suggest a diagnosis of malignant disease. It



FIG. 47.—Impaction of a large oval calculus in the extremity of the common bile-duct, a portion of the stone projecting into the duodenum. The patient was a very large woman, seventy years of age. For nearly six months before death she had been subject to spasmodic pains at the stomach, which came on with shivering, like an ague fit, continued from half an hour to an hour, and were succeeded by unnatural heat. To these were added in the last month of life frequent vomiting, great thirst, and a deep jaundic colour of the skin. Three days before death she was suddenly seized with unusually severe shivering and pain, which extended quite round the abdomen, and continued without remission until her death. The liver after death was found pale, soft, and fragile. The gall-bladder contained numerous small angular calculi; both it and all the bile-ducts were distended, and all their coats were greatly thickened; the stomach appeared healthy (Royal College of Surgeons' Museum, No. 2826).

is more than likely that some measure of responsibility for this symptom may rest with the pancreas, whose

secretion may be profoundly modified both in quality and in quantity by an extension of the inflammation from the common duct to the canal of Wirsung into the substance of the pancreas. Chronic pancreatitis is by no means an uncommon event in long-standing obstruction of the common duct, wherever the obstruction may be.

The characteristic signs and symptoms of stone in the common duct, therefore, are: Persisting jaundice, which alters considerably in depth of tinge, varying between morning and night, becoming markedly deeper after an attack of pain and gradually lessening in the intervals. The jaundice may be said to ebb and flow. Pain which comes on in "attacks." The pain is diffused over the whole hepatic area, is constant, and is liable to acute exacerbations. During an exacerbation there is a rigor, and a temperature of 103° or 104° is quickly reached, and nausea and vomiting are present. During and after an attack there are tenderness and enlargement of the liver, and probably also of the spleen. Bile enters the intestine in small quantities, as a rule; but after a paroxysm the quantity, as shewn by alterations in the urine and the fæces, is lessened. Itching of the skin is always present. There is rarely any enlargement of the gall-bladder, and ascites is absent, unless, as very rarely happens, there is pressure upon the portal vein. The paroxysms are ague-like in character and may occur with remarkable regularity. Osler has attempted to associate a special symptom group with ball-valve stone, which is most commonly found in the ampulla of Vater.

“(a) Ague-like paroxysms, chills, fever, and sweating; the hepatic intermittent fever of Charcot.

“(b) Jaundice of varying intensity which persists for months or even years and deepens after each paroxysm.

“(c) At the time of the paroxysms, pains in the region of the liver, with gastric disturbances.”

The cause of the attacks is probably to be found in a renewed attempt on the part of the duct to expel the stone. From the dilated portion of the duct the stone is made to enter the narrow portion, and a spasmodic muscular contraction is set up. In this way a fresh damage is done to the duct, tension is increased, infection occurs, a cholangitis, or an increase of an inflammatory condition already in existence, takes place, and the mucosa throughout the ducts swells and narrows the lumen. The obstruction, in fact, becomes for the time mechanically complete, and partly for this reason, partly because of the renewed attack of cholangitis, the jaundice deepens. It is doubtful if an infective process once set up in the common duct ever disappears unless the obstructing agent is removed. There is always retention of bile behind the stone, and therefore a ready opportunity for the constant proliferation of organisms.

The existence of cholangitis is shewn by the presence of jaundice and of fever. If a stone be lodged in the common duct and neither of these be present, it may be taken that cholangitis does not exist, and that the bile is free from organisms.

In the most severe forms of infection suppuration may arise in the duct. It is certain that infection is present

in all cases attended by the symptoms just enumerated; it is equally certain that the infection rarely gives rise to suppuration. When a stone is removed from the common duct, even when jaundice is marked and long-enduring, it is, in my experience, very rare to find pus in the ducts, however severe the clinical manifestations may have been. Some authors, Kehr and others, talk of fetid pus as being not uncommonly found behind a stone in the common duct. In my experience it is almost unknown.

A suppurative cholangitis, therefore, is a rare complication of impacted stone. It is also a most serious, often indeed a lethal, one. The suppuration may extend not only along the whole length of the common duct, but also may involve the cystic duct and the gall-bladder (giving rise to empyema) and the hepatic ducts. In some cases an abscess or abscesses may develop in the liver by direct extension of the infection along the ducts. In cases of multiple abscesses the symptoms are those of profound septic poisoning. The temperature remains high, losing its "steeple" projections, rigors may occur frequently, and the general health and strength of the patient are rapidly enfeebled. There may be signs of peritonitis over and around the liver and fluid may be found in the right pleura. There may be a subphrenic abscess. The spleen becomes larger and very tender.

When the abscess is localised, a swelling on the surface of the liver may be palpable. This is tender to the touch, especially, as Naunyn and Osler point out, during the hours that succeed a rigor. The jaundice is not so deep, nor are the variations so noticeable. The clinical presentment is, it will be seen, one of a severe septicæmia, ac-

accompanied by signs of intense inflammation in the gall-ducts.

A gall-stone may remain in the common duct for years. In one of my patients the symptoms had been present for nine years. One of the consequences of so long-enduring an inflammation in the duct is that the head of the pancreas may be involved by infection of Wirsung's duct, or, perhaps, by direct or by lymphatic infection. Chronic pancreatitis, as was pointed out by Riedel, is a not infrequent complication of gall-stones impacted in the common duct. Opie has shewn that in all probability many cases of acute pancreatitis are due to the impaction of a stone of small size in the ampulla of Vater. In such a case the symptoms come on with marked suddenness. They are epigastric pain and tenderness, followed by distension, vomiting, and collapse. The diagnosis most often made is one of intestinal obstruction. In acute pancreatitis, with fat necrosis, there is no increased leucocytosis; in acute infective cholangitis there is a marked leucocytosis.

The following are a few cases selected from a large number upon which I have operated:

Stone in Common Duct: Duodeno-choledochotomy.—M. A. R., female, aged forty-one, admitted March 23, 1901, with jaundice. For eight or nine years has been subject to attacks of pain in the right hypochondriac region, and pain after food in the epigastrium and "right round the body." Sixteen months ago for the first time an attack was followed by jaundice. The pain came suddenly and overwhelmed her. She was in bed with pain and soreness for three days. On the third day

jaundice was observed. Four months ago a similar attack, and since then five attacks similar in character, but varying in intensity. She was deeply jaundiced four months ago and has been jaundiced since, though the depth of colour has varied very much. When the last attacks have commenced, she has felt cold and shivery, and in a few minutes she has broken out into profuse sweats. Nothing to be felt in the abdomen. On opening the abdomen the gall-bladder was found shrunk and thickened; it was freed from adhesions, opened, and seven stones removed. A large stone was felt in the ampulla of Vater; an attempt to push it back into the common duct failing, the duodenum was opened and the ampulla incised and the stone removed. The duodenum was closed and the gall-bladder drained. The patient was discharged well on April 23, 1901.

Stone in Common Duct: Choledochotomy.—M. A. C., female, aged thirty-three, admitted with deep jaundice January 11, 1899. In May, 1899, she had an attack of pain in the region of the xiphisternum, passing round the right side to the scapula. The pain was very severe, produced faintness and collapse, and was accompanied and followed by vomiting. Jaundice followed two or three days later. Several similar though slighter attacks since. For eight weeks has not been free from jaundice, though there has been considerable variation in its tinge. Each attack has caused profuse sweating.

On November 7th the abdomen was opened. The pyloric end of the stomach was found to be embedded in adhesions with the under surface of the liver and gall-bladder. After freeing the bladder and ducts two stones were felt in the common duct: one was crushed and passed onwards into the abdomen, the other was fixed and was removed through an incision in the duct; it was of the size of a small Barcelona nut. The duct was stitched

and a Bantock's tube introduced. The patient was discharged well on December 3d.

Stones in Common Duct: Choledochotomy.—C. W., female, aged forty-two, admitted March 7, 1900. Patient admitted with jaundice. For several years has had occasional attacks of "spasms," followed by slight jaundice. No attack has lasted more than a few hours, and has never incapacitated her for more than a day, or perhaps two, from her work until five months ago, when she had a severe attack, followed by jaundice. Pain and jaundice have been present ever since, varying in intensity, but never very severe. During the last few weeks has felt cold, and shivered when an attack was impending; soon afterwards has sweated profusely. The motions have been very pale for five months and the urine high-coloured.

At the operation a small, thick, adherent gall-bladder was opened and relieved of forty-six stones which lay within it and the cystic duct. The common duct had seven small stones in it; these were removed by a separate incision, which was stitched up directly. The gall-bladder was drained. The patient was discharged, quite well, on March 31st.

Stone in Common Duct: Choledochotomy.—Mrs. G., aged fifty-eight, admitted June, 1901. The first attack of biliary colic occurred at Christmas, 1896. This had been followed by others at almost regular intervals of three months until January, 1901, when the severest attack of all took place. She was confined to bed after it for three months, and it was after this that she suffered from continuing though varying jaundice. Shivering was noticed on several occasions; on each the pain was rather worse and the jaundice a little deeper.

Operation, June, 1901.—There were a host of adhesions around the common duct, gall-bladder, and duodenum. A stone was felt tightly fixed in the common

duct near the termination of the cystic duct. An incision was made on to it and a stone equal in size to a Barcelona nut evacuated. A couple of drachms of pus followed the stone. The common and hepatic ducts were thoroughly explored and found to be clear. A large drainage-tube was fixed by one stitch into the common duct and the abdominal wound closed round the tube.

After the operation there was retention of urine, and cystitis followed upon catheterism. Healing of the wound was delayed by cellulitis, due probably to infection from the pus escaping from the common duct. Bile was discharged freely from the wound for several weeks. A year later the patient was quite well, and her doctor informed me that "the relief from operation has been complete."

Stone in the Common Duct: Choledochotomy.—Miss B., aged fifty-five, May, 1902. Sent by Dr. Clarke, Doncaster. Two and a-half years ago had the first attack of jaundice, preceded by an extremely severe attack of pain lasting two days. The jaundice passed away in fourteen days, and afterwards she felt quite well. In December, 1901, a similar attack of pain over liver, passing through to the right scapula, was followed by jaundice slight in character and lasting only five days. After recovery from this attack she felt weak, easily prostrated, and had a "loathing for food." Flatulence was distressing, and her weight gradually decreased. Six weeks before admission a similar attack of pain, followed by jaundice; since then jaundice has varied in depth of tinge, but has never disappeared; pain has varied, but a dull aching sense of oppression and weight has always been present. She has had several shivering attacks during the last six weeks. She has lost one and one-half stone in the last three months. The jaundice is said by her friends to be less in the morn-

ing, and to get gradually deeper in tinge during the day. On examination there were tenderness and rigidity in the gall-bladder area. Nothing definite felt.

Operation.—A long incision was made. The gall-bladder was found buried in adhesions thick and contracted. There were many adhesions between the abdominal wall, the liver, duodenum, transverse colon, and bile-ducts—so firm and so widespread that rotation of the liver was not possible. A stone was tightly wedged in the common duct about one inch from its junction with the cystic duct. As the common duct could not be brought to the surface, it was necessary to cut down upon the stone in the duct and to remove it with a scoop. The stone was of the size of a nutmeg. The hepatic and the rest of the common duct were explored, but no other stone discovered. A large tube was fixed into the opening made into the duct and the abdominal wound closed.

The tube came away on the eleventh day. The wound rapidly healed, and the patient is now quite well and free from pain, discomfort, and jaundice.

THE DIFFERENTIAL DIAGNOSIS OF STONE IN THE COMMON DUCT.

In many cases, certainly in the majority, the diagnosis of stone in the duct is correctly made with the most positive assurance; in other cases the surgeon may waver in his diagnosis, being uncertain as to whether a calculus alone is present, or as to whether a stone is associated with some other condition whose symptoms are similar, or, finally, as to whether the symptoms suggestive of stone are being caused by an entirely different condition.

In the characteristic case of common duct obstruction

by stone jaundice is always present and is remarkable for the great variation it shews in depth of tinge. Jaundice, however, is not an invariable sign in cases where stones are found in the common duct during operation or at an autopsy. Even when the blood is examined by Hamel's method, no yellow discolouration may be found. In the absence of jaundice, however, it is almost impossible to arrive at a correct diagnosis. Jaundice therefore is the cardinal symptom of common duct obstruction, and is distinguished by a perfectly characteristic "ebb and flow" in those cases in which the stone forms a "ball valve," that is, in the very great majority. The "ebb and flow" is, however, in a certain number of cases very slight, and may escape notice by the patient, or those who are in immediate contact with the patient, and only obtain recognition after the medical man has given instructions for precise observations to be made.

Of all the conditions which simulate calculous obstruction of the common duct, probably none is so difficult to differentiate as chronic pancreatitis. The frequency of their association is now well recognised, but it is not so generally understood that even after a stone has passed, after long detention in the duct, the thickening of the head of the pancreas which has been left behind may cause a remarkable mimicry of the symptoms of stone. The "pancreatic reaction" given by Cammidge's test may, if experience prove it to be reliable, shew the existence of pancreatitis, but does not permit a distinction between the two diseases. It enforces, however, the imperative need of operation, in order to prevent a permanent and increasing damage to the pancreas.

When the gall-bladder is distended, we know, by "*Courvoisier's law*," that in all probability the jaundice is caused not by stone, but by growth or inflammation pressing upon the duct. In chronic pancreatitis the gall-bladder may be dilated, even when the pancreatic inflammation is primarily caused by the stone irritation. In the first recorded cases of typhoid pancreatitis I had diagnosed stone in the common duct from the symptoms, yet found that the sole cause of the intermitting jaundice was a condition of chronic inflammation of the pancreas; the gall-bladder was distended with bile containing an abundance of the organisms of typhoid fever. Courvoisier's law, therefore, though of enormous value clinically, is not invariably true. But what law is?

CHAPTER VI.

REMOTE CONSEQUENCES OF GALL-STONE DISEASE.

The chief of these are biliary fistulæ and their complications, perforation of the gall-bladder into the peritoneum, and intestinal obstruction.

Biliary Fistulæ.—Biliary fistulæ may form between any part of the bile-tract, on the one hand, and the surface of the skin or of any of the hollow viscera, on the other. They are conveniently classified as *external and internal*. The following table, compiled by Naunyn, indicates the frequency with which the various fistulæ were found in a series of recorded cases:

Between the bile-ducts themselves.....	8
Retroperitoneal	4
Gastric—total	12
Gastro-hepatic	4
Between stomach and gall-bladder	8
Duodenal—total	108
Common duet and duodenum	15
Gall-bladder and duodenum	93
Between gall-bladder and jejunum	1
Between gall-bladder and ileum	1
Colic—total	50
Between gall-bladder and colon	49
Between common duet and colon	1
Urinary passages	6
Thoracic viscera	10
Abdominal wall	184
	<hr/>
	384

This table is not supposed, even by its compiler, to

represent with anything approaching accuracy the true state of affairs. For, as Naunyn points out, fistulæ of the abdominal wall have always attracted, indeed, compelled, observation, and other fistulæ, those, for example, implicating the urinary passages, are so remarkable and unexpected as to seem worthy of especial record. The intestinal fistulæ, on the other hand, produce no symptoms; indeed, their formation always affords relief to symptoms which may often have menaced the patient's life. They are discovered, moreover, only after tedious dissection, and are, therefore, on all grounds, liable to escape notice.

External biliary fistulæ may be due to disease or may follow operation. The fistula almost invariably implicates the gall-bladder, and is the result of an empyema. The suppurative cholecystitis may be due to the blockage of a stone in the cystic duct, or be independent of calculous disease. As a result of the acute inflammation of the gall-bladder, adhesions are formed to the abdominal wall, the gall-bladder perforates, an abscess forms, and at length the skin gives way. When the abscess discharges, some or all of the gall-stones may escape from the fistula, which may then close spontaneously. As a rule, a single fistulous opening is present and is situated in the right hypochondrium or near the umbilicus; but there may be several fistulæ, and these may open anywhere upon the abdominal wall. A case of fistula discharging "exactly over the normal position of the appendix" is recorded by Gibbon (*Phil. Med. Journ.*, 1901). Porges (*Wien. klin. Woch.*, 1900, No. 26) has described a case in which a fistula upon the thigh discharged gall-stones.

The inner end of the fistula may communicate with

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the cystic, or common, or hepatic ducts, or it may follow the opening of a hydatid cyst or hepatic abscess, and will then be in relationship with the intra-hepatic ducts. In addition to acute suppurative cholecystitis, injury by stab or gunshot wound may be mentioned as causes.

Biliary fistulæ after cholecystotomy were formerly not infrequent. Now-a-days they are rarely seen. In the earlier operations it was considered necessary to stitch the gall-bladder to the skin, and a fistula was, therefore, to be expected. Since the gall-bladder has been fixed, as a rule, to the aponeurosis, a fistula has become an extreme rarity.

The external opening in Courvoisier's series of 169 cases was situated as follows:

In the right hypochondrium	49
At the right costal margin	36
On the right side of the epigastrium	17
In the right iliac region	10
In epigastrium	6
Near the umbilicus	22
At the umbilicus	12
Below the umbilicus	11
In the left groin	1
Multiple openings	1

Internal Biliary Fistulæ.—These may connect any one part of the bile-tract with any other part. Clinically, as will be understood, they have little interest.

Fistulæ between the gall-bladder and the duodenum are common; those between the cystic duct and the duodenum are rare; those between the common duct and the duodenum, far more frequent than is generally believed, owing to the fact that many cases, in reality fistulous, have been regarded as examples of unduly large

ampullary openings. The hepatic duct has not been known to form a fistulous communication with any part of the intestine.

The following is the record of a case of cysto-duodenal fistula upon which I operated:

K. H., female, aged fifty-five, admitted February 9, 1901, complaining of pain in the right epigastric and hypochondriac regions. The pain is intermittent in character, comes on daily and unexpectedly, lasts a few hours, and then disappears. It is three months since the first attack; since then the spasms have increased in severity and frequency. When an attack comes on she feels cold and faint and almost collapses. She has never been jaundiced. A fortnight ago a tumour appeared on the right side of the abdomen, described by the doctor as "a hard, smooth, globular tumour, larger than a golf ball." No tumour can be felt now.

Operation, on February 15th. The abdomen was opened through the outer part of the right rectus muscle. On exposing the gall-bladder and adjacent parts the following condition was found. The gall-bladder was distended with a grumous material; to its outer surface the omentum and the duodenum were adherent; the omental adhesions separated fairly easily, the duodenal with difficulty. On detaching the duodenum an opening



FIG. 48.—Ulceration and perforation of gall-bladder into peritoneal cavity, probably due to calculi (Guy's Hospital Museum, No. 1398).

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was found between it and the gall-bladder; there was, in fact, a fistula equal in diameter to a lead pencil between the two viscera. In the cystic duct a stone about the size and shape of a nutmeg was found tightly impacted. The gall-bladder, cystic duct, and stone were removed, the cut end of the duct being ligatured close to the common bile-duct and the stump covered with peritoneum. The opening in the duodenum was closed with sutures and a split drainage-tube with gauze wick passed down to the common duct. Recovery was uninterrupted and the patient left the hospital on March 12th.

Mr. Cammidge examined the gall-bladder and reported: "Great increase of fibrous tissue and patches of small-celled infiltration, and patches of calcified material. No evidence of malignant disease in the material examined."

An interesting case of cysto-duodenal fistula is recorded by Pozzi, in which the stone was found to lie partly in the gall-bladder and partly in the duodenum.

The gall-bladder may communicate with the stomach, and its clinical recognition may readily be made by observing the persistent vomiting of bile. According to Naunyn, not more than a dozen cases are recorded. The following is a good example:

Fistula between stomach and gall-bladder. Mrs. T., aged fifty. Seen with Dr. Galloway, Otley, April, 1902. Nine years ago had an attack of typhoid fever. Five years ago began to suffer from "spasms" at intervals of a week to a month. Jaundice followed on every occasion. Four months ago had a very severe attack which was not followed by jaundice; the pain was acute and intolerable in the right hypochondriac region and in the



FIG. 49.—Shewing a large fistula leading from the fundus of the gall-bladder into the duodenum, through which a large calculus had passed. Other calculi are still contained in the gall-bladder. During the passage of the gall-stones along the intestine the adhesions between duodenum and gall-bladder were ruptured during the violent vomiting of the patient. Extravasation into the peritoneal cavity occurred. From a woman, aged twenty-seven. She suffered from symptoms of acute peritonitis, and died in seven days. At the inspection the peritoneal cavity was found to contain bloody serum. The small intestines were extensively distended from the stomach to within a few inches of the termination of the ileum, while the cæcum and colon were contracted and empty. At the spot where the distension ceased a large biliary calculus was found which entirely filled the canal (*vide* Trans. Path. Soc., vol. 1, p. 255). (Royal College of Surgeons' Museum No. 2828.)

epigastrium; vomiting was severe; after two days bile was noticed in the vomit. From that date she has vomited almost every day, and on all occasions bile has been present in the vomit. For the last month she has vomited daily between ten and thirty ounces of bile, little, if at all, altered. She has steadily lost flesh; in all about three stone in weight have been lost in four and one-half months. The vomiting is not attended by pain, but comes on suddenly, and about ten ounces are ejected at one effort. The right hypochondriac region and the epigastrium were tender. No blood was seen in the vomit and the stomach was not dilated. The diagnosis rested between fistula communicating with the gall-bladder, on the one hand, and the stomach on the other, and infra-ampullary growth in the duodenum. The history pointed strongly to the former, and it was that which I accepted.

As I was at the time suffering from a poisoned wound of the hand I was unable to operate myself. My colleague, Mr. W. H. Brown, in whose beds she was, kindly undertook the operation for me. He found a fistula between the fundus of the gall-bladder and the anterior wall of the stomach near the pylorus. The gall-bladder and stomach were detached, the opening in the stomach closed, and the gall-bladder drained. The stitches used to close the stomach opening were applied with difficulty, as they cut through the friable stomach wall very readily.

The patient died forty-eight hours after operation, and it was found that two of the stomach sutures had given way.

In some instances gall-stones have been vomited, as is recorded by Oppolzer, Miles, Frerichs, Murphy, myself, and others. Hayem has recorded a case where gall-stones were evacuated through a stomach-tube. Van der

Byl has related the history of a case in which gall-stones were vomited; at the postmortem a cysto-duodenal



FIG 50.—Gall-stones biliary obstruction; cholecysto-colic fistula. The gall-bladder is adherent to the liver, thickened and contracted, and contains a gall-stone. The colon is adherent to the fundus, communicating with it by several ulcerated openings. The common bile-duct admits the middle finger, a calculus being lodged at its end. One and a half inches above the papilla is seen an opening in the wall of the duodenum leading into the dilated duct above the stone. From a man, aged sixty, who was admitted for slight jaundice of sixteen months' duration and enlargement of the liver. Death took place sixteen weeks later; the body was deeply jaundiced. There was tuberculous disease of the meninges, lungs, pericardium, peritoneum, and spleen (Guy's Hospital Museum, No. 1423).

fistula was found. The duodenum is more commonly involved than either the colon or the stomach, as might

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be anticipated from the anatomical relations of the parts. The jejunum and ileum are rarely affected.

The preparatory stages in the formation of fistulæ connecting the gall-bladder with the stomach, duodenum, or colon can not seldom be seen during the performance of operations. The gall-bladder may be found intensely adherent, and, in separating it, its walls may be torn or the intestine or stomach may be opened. Or, on completely effecting the separation, it can be seen that the walls on one or other side are thinned and that the peritoneal coat is wholly lost. In such conditions a fistula would soon have developed. A further step is seen in those cases in which the gall-stone has ulcerated completely through the walls of the gall-bladder, but has not reached the general peritoneal cavity, owing to the protective barriers formed by the copious outpouring of lymph. Such cases are recorded by Sharman (*Med. Times and Gazette*, 1859), and Mr. Simon (*Trans. Path. Soc.*, vol. 5, p. 156) quoted two cases from St. Thomas's Hospital, where a process of discharge of stones from the gall-bladder had appeared to be in progress at the time of death. In one (whereof the specimen is preserved in the museum) there was found beyond the fundus of the gall-bladder a cyst, constructed of dense cellular tissue, communicating with the gall-bladder by a small ulcerated opening and completely filled in its interior by a concretion of cholesterin. In another of such transitional cases (*Postmortem Book*, October 19, 1850) the fundus of the gall-bladder was found communicating by an ulcerated opening a quarter of an inch in diameter, with a cyst about as large as a pigeon's egg, formed of dense,

cellular tissue, coherent with the abdominal wall anteriorly and filled with irregular masses of concrete biliary matter and small calculi.



FIG. 51.—Gall-stone removed from the ileum by operation. The stone is two inches long, more than one inch in diameter, weighs 238 grains, and is moulded to the shape of the gall-bladder. The gall-bladder is thickened and contracted, and there is a fistulous communication between it and the bowel, the parts being united by firm adhesions. The anterior edge of the liver is thin and bent back upon the upper surface of the organ. From a woman, aged fifty, who was admitted with symptoms of acute intestinal obstruction of three days' duration, never having previously suffered from any illness except occasional dyspepsia. At the laparotomy the peritoneum was found to be acutely inflamed. After death which took place seventy hours later, the incision in the piece of gut separately shewn was found to be 12 inches above the cæcum (Guy's Hospital Museum, No. 1455).

In cases where gall-stones of large size are found in the fæces, or when intestinal obstruction results from the plugging of the lumen of the gut, it is certain that in almost every instance the stone has passed, not through the

common duct, but through a fistula. The largest stones that have been known to pass are referred to subsequently. After the stone or stones have escaped from



FIG. 52.—Cholecysto-duodenal fistula; gall-stone impacted in the ileum. The gall-bladder is thickened and contracted and firmly adherent to the duodenum. The fistula easily admits the middle finger. The opening into the intestine is situated about one inch from the pyloric ring. The stone measures one and one-half by one inch. From a woman of fifty-nine, who was admitted for intestinal obstruction. For six days she had suffered from constipation, vomiting, and abdominal pain. Two days later an artificial anus was established in the small intestine. Death ensued in six hours. The stone was impacted 33 inches above the ilco-cæcal valve (Guy's Hospital Museum No. 1399).

the bile passages into the intestine, the fistulous track may close. Roth observed one such instance. *Fistulæ* from the gall-bladder generally open near the fundus,

but any part down to and including the cystic duct may be involved.

The occurrence of choledocho-duodenal fistulæ is probably far more common than is generally recognised. When the first or second portions of the duct are implicated, a recognition of the fistula is easy; but when the transduodenal portion is involved, the appearances presented are most deceptive. If a stone be blocked in the ampulla, it may break loose by causing ulceration of the papilla, or of the lower part of the duct, as it lies within the duodenal wall. The lower end of the duct then appears to open by a long slit in the duodenum rather than by a minute orifice on a pout of mucous membrane. Many records speak of a "wide-mouthed termination," or "an abnormally large opening" of the common duct. In reality a choledocho-duodenal fistula is present.

There are no symptoms which are especially due to any of these varieties of fistula. In many cases their formation might be expected to afford relief to long-troublesome symptoms, but their discovery, in most cases, is a matter of chance. If, for example, an impermeable block were present in the common duct, the formation of a cysto-duodenal fistula, or of a choledocho-duodenal fistula, the former, imitated by the surgeon in the operation of cholecystenterostomy, would give relief to all the symptoms.

The following are the notes of a case in which a fistula was diagnosed, with every probability of accuracy:

Dr. M. S., aged fifty-eight, had suffered for several years from "indigestion," epigastric colic, and occasional

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vomiting. Seven months before I saw him he became jaundiced for the first time, after an attack in which the foregoing symptoms were unusually severe. The jaundice persisted, but shewed the ebb and flow characteristic of ball-valve stone in the common duct. There were the usual symptoms of ball-valve stone, rigors, sweating, pains in and around the hepatic area, slight, transient enlargement and tenderness of the liver, during the whole of the seven months. I advised operation, in order that the stone in the common duct should be removed. While debating the matter an attack of colic of the usual type began. Three days later a stone, as large as a nutmeg, was passed; the jaundice, after deepening, gradually cleared away, and for the last four and one-half years there have been no symptoms of any kind. After the discovery of the large stone no further search was made, and it is, therefore, impossible to say whether others were passed.

When intestinal obstruction follows speedily upon an attack of pain, swelling, and tenderness in the hepatic region, and a gall-stone is recognised as being the cause of the block, it will be clear that, in all probability, a fistula has formed. Such cases are not unusual. Fistulæ between the gall-bladder and the colon are not infrequent. They may be diagnosed when a large stone is passed per anum without any biliary or intestinal discomfort having been observed. As a rule, the beginning of the transverse colon is joined to the gall-bladder. As Courvoisier was the first to point out, a cysto-colic fistula is not seldom associated with other fistulæ, cysto-duodenal, choledocho-duodenal, and so forth. One example of fistula between the common duct and the

colon is recorded. Riedel relates a case of cysto-colic fistula in which death occurred four hours after the perforation of the gall-bladder near its point of junction with the colon. Fæces and gall-stones were found free in the peritoneal cavity.

Among the surgical curiosities are fistulæ which have formed *between the bile passages and the urinary tract*. I have once seen a gall-stone, which had escaped from the gall-bladder into a renal pelvis, dilated behind an impacted ureteral calculus. A stone so placed may escape into the bladder. Guterbock has performed lithotritry and Bier lithotomy for what were found to be gall-stones. Murchison records a case where 200 gall-stones were passed from the bladder. In such rare cases the tract between the gall-bladder and the urinary passages may be very long and tortuous.

It has, indeed, been shewn that a path may be created along the round ligament of the liver to the umbilicus, and thence along a patent urachus to the bladder.

Pelletan records a case of gall-stone impacted in the urethra which was pushed onwards by the pressure of a finger in the vagina. This stone was the last of 200 little stones that were passed within a period of eight days.

Faber records the case of a man who suffered for four years from gall-stone disease; calculi passed by the bowel, and nine small and four large stones were voided with the urine. One of these became impacted in the urethra and the patient himself extracted it. A second stone became impacted, and this could only be removed after the performance of external urethrotomy. The stones were passed between the years 1834 and 1838. The

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patient died in 1863, and a postmortem examination shewed the existence of a connecting strand between the gall-bladder and the urinary bladder. The upper half of this strand consisted of the gall-bladder, the lower half of a patent urachus.

Abt records the case of a woman thirty years of age who suffered for eleven months from gall-stone attacks. Eleven calculi were passed in the urine and recovery speedily followed.

J. Israel communicated a case to Langenbuch, which the latter records, in which a gall-stone was found in the urinary bladder.

Cases are recorded in which operative treatment has been adopted by Kocher, von Bergmann, and Krönlein. In Krönlein's case a communication existed between the gall-bladder and the urinary bladder through a patent urachus. The gall-bladder was removed and the urachus closed. The patient, a woman aged fifty-six, died three days later as a result of the giving way of the ligature upon the cystic duct.

Von Bergmann's patient was a woman sixty-three years of age who had suffered for eighteen years from pain and inflammatory swelling in the right hypochondrium. A tumour the size of a fist formed in the neighbourhood of the umbilicus. This was opened and gall-stones were removed from what was recognised as being a dilated urachus. The patient recovered.

Fistulæ Between the Bile Passages and the Female Genital Organs.—In one very remarkable example related by J. P. Frank, in 1790, a gall-stone is supposed "to have passed along a fistula between the gall-bladder

and the uterus, and to have escaped from the vagina during labour." The case, however, is open to question. The patient, at the age of twenty-two, had suffered, when pregnant, from severe pain to the right of the uterus. After confinement there was profuse hæmorrhage. Three months later a hard, round lump was felt to the right of the uterus. It remained stationary in size, but was very painful during menstruation. Pregnancy occurred after eight years, and at once the swelling increased in size and became continuously painful. After a few weeks pus escaped from the vagina. An incision was made into the swelling and pus was evacuated. From this opening pus continued to escape and the discharge from the vagina gradually lessened. After some weeks a sudden pain was experienced, followed by shivering, jaundice, and convulsions. Bile was discharged from the fistula and from the intestine. A gall-stone escaped into the vagina, and later twenty-five were passed in the fæces. Delivery was induced at the seventh month. The closure of the fistula speedily followed. There is here no mention of the escape of the stone during labour. The case is one either of vaginal or uterine fistula. More than that cannot be said.

Two cases are recorded by Osler and Kummell in which a stone-containing gall-bladder became adherent to the broad ligament and the ovary. A case of biliary fistula between the gall-bladder and the pregnant uterus is mentioned by Faber. R. H. Lucy (*Lancet*, April 21, 1900, p. 1132) records a case of ovarian cyst communicating with a thickened gall-bladder containing a solitary calculus. The contents of the ovarian cyst were bile-stained.

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Fistulæ may connect the *bile passages and the thoracic organs*. A subphrenic abscess, or an intense inflammatory deposit, may form as the result of an empyema of the gall-bladder or an abscess of the liver. The pleura may become adherent on the upper surface of the diaphragm, and when the wall of the gall-bladder or of the abscess gives way, the gall-stones may escape into the lung, and there cause an abscess to form. Gall-stones, bile, and pus may be coughed up, and the taste of bile may be recognised by the patient. Cayley has recorded a case where gall-stones entered the left pleura from the left lobe of the liver; Simons one where the mediastinum was opened; and Wickham Legg one in which the pericardium was involved. Vissering and Colvée have recorded cases in which gall-stones were expectorated. Harley found stones in a pleural effusion. So far, almost all such cases have proved fatal.

Courvoisier, in his work, collected twenty-four cases of fistulæ between the bile passages and the pleura of the lungs. Graham (Brit. Med. Journ., vol. 1, 1897, p. 1397) published ten additional cases, including two observed by himself. In Courvoisier's series of cases a necropsy was performed in eighteen cases; in ten of these the fistula was found to be secondary to gall-stones. The usual sequence of events in these cases is (1) occlusion of the common bile-duct; (2) suppurative cholangitis, extending upwards to the liver and causing biliary abscess; (3) adhesions of the liver to the under surface of the diaphragm; (4) adhesions of the lung to the upper surface of the diaphragm; (5) perforation of the liver, diaphragm, and lung and escape of bile into the bronchi.

In a very few cases surgical treatment has been attempted. The following case is recorded by Mr. Rigby (Brit. Med. Journ., vol. 2, 1903, p. 313):

History.—A female patient, aged fifty, was admitted into the Poplar Hospital on December 14, 1902, with the following history:

She had been an in-patient in the Radcliffe Infirmary, Oxford, eighteen months ago, owing to a severe illness which lasted for six weeks. The symptoms, which were acute for the first week after admission, were those of cholangitis, due probably to gall-stones, jaundice, pyrexia, and pain in the right hypochondriac region being present. The acute symptoms gradually subsided and no operative treatment was carried out.

About ten days before admission she had a severe fit of coughing, which resulted in the expectoration of some green fluid with a very bitter taste; since that time she had been troubled with a persistently distressing cough and expectoration of similar fluid. She had kept in bed and lived on milk diet for the last ten days. She thought she had wasted a good deal.

Condition on Admission.—A fairly well-nourished woman, looking somewhat prematurely aged. The colour of the face appears normal, but the conjunctivæ are a little yellow. The tongue is red and clean. She is not in pain, but complains greatly of cough, which is frequent and distressing. After each fit of coughing she brings up with but little effort a drachm or two of dark-green frothy fluid expectoration, which she says has a bitter, unpleasant taste. She cannot lie down at all, owing to this persistent desire to cough. There is no pyrexia.

The lungs on examination show well-marked signs of emphysema, as evidenced by hyper-resonance, with prolonged expiration; rhonchi and râles are audible on both

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sides; the heart sounds are clear, and the apex beat is heard in the normal position.

The abdomen is flaccid, but examination in the recumbent posture is difficult, owing to the incessant desire to cough. The liver can be felt below the costal margin for about two fingerbreadths, and on percussion dulness corresponds with this. There is no increase of liver dulness in an upward direction. Some tenderness is evinced on palpation over its anterior margin and in the gall-bladder region, but this is slight, and nothing resembling an enlarged gall-bladder can be felt. No rub can be felt over the liver region. The rest of the abdomen, both to percussion and palpation, appears normal.

The sputum was carefully examined and gave the characteristic reactions for bile, which appeared to be present in considerable quantities.

Operation.—On February 17th the patient was anæsthetised with A. C. E. mixture, and the following operation performed by Mr. Hugh Rigby. A sandbag was first placed transversely beneath the lower dorsal region. An incision was then made in the upper part of the right linea semilunaris, three and one-half inches in length. The liver came into view on opening the peritoneum. It was enlarged downwards, its edge extended one and one-half inches below the costal margin, it appeared congested, and its anterior border was rounded.

The fundus of the gall-bladder was seen, but the body of this viscus was concealed from view by the hepatic flexure of the colon, which was adherent to it and to the inferior surface of the liver. The adhesions were carefully separated; the colon was found to be firmly fixed at one point to the liver, to the right of the gall-bladder. In separating this the wall of the gut was slightly torn; the opening was immediately closed by two Lembert sutures of silk. The gall-bladder, cystic and common bile-ducts

were then exposed. The gall-bladder was found to be empty, contracted, and its walls thickened and fibrous. The cystic duct was slightly dilated. The common duct was distended to about the size of one's forefinger. Some calculi were felt low down in the common duct behind the head of the pancreas.

An incision one inch in length was made in the common bile-duct, above the first part of the duodenum. A good deal of dark bile escaped, which was quickly sponged away. By means of a finger and thumb the calculi were squeezed up from behind the pancreas and first part of the duodenum, and made to present in the wound in the duct, and were then extracted without difficulty. There were two calculi present. After their extraction a probe could be easily passed down into the duodenum. The opening in the common bile-duct was then closed by two rows of sutures, one for cut edges of the wound and another for serous covering by Czerny-Lembert method. The gall-bladder was next sutured by silk to the peritoneum of the wound in the belly wall at its upper part, and the rest of the wound closed by silkworm-gut sutures.

The fundus of the gall-bladder was incised and a small drainage-tube inserted, but no bile escaped at all from the gall-bladder. A gauze drain was passed down to the opening in the common duct through the lower part of the abdominal wound. The calculi were facettèd, dark green in colour, and evidently composed of bile pigment and cholesterin. The larger was the size of a marble, the smaller, that of a hazelnut. The patient made a good recovery.

Perforation of a stone from the common bile-duct into the portal vein has been observed on four occasions; in one, a stone lay partly in the pelvis of the gall-bladder

and partly in the vein; in one, a stone half an inch in length had ulcerated into the vein adherent to the head of a malignant pancreas; in one, there was a subhepatic abscess; in one, a stone 2 cm. in length, composed of cholesterin, lay in the portal vein, and other smaller stones were found in the branches. Thrombosis of the portal vein due to compression by a stone in the hepatic or common ducts is also recorded. Ascites may be caused by thrombosis, and also by direct pressure upon the portal vein by the stone. In several instances stones have been found to have ulcerated out of the bile passages and to lie in cavities of the liver substance, or to be confined within an abscess cavity hemmed in by peritoneal adhesions. I have met with several examples of the former and with one of the latter condition, in operations for gall-stones.

In rare instances multiple internal fistulæ may be present. Ignatius Loyola is said, upon the authority of Realdo Colombo, to have suffered from gall-stone disease, and gall-stones were found in the liver, portal vein, kidneys, and lungs. Morgagni remarks that the intra-hepatic ducts were probably mistaken for the portal vein.

Internal and external fistulæ may both be present, as in the following very remarkable example recorded by Leonard Rogers (*Brit. Med. Journ.*, vol. 2, 1903, p. 706):

The patient, a man, was first admitted to St. Mary's Hospital for empyema of the gall-bladder, which was successfully drained, the pus being bile-stained. The wound healed and the patient left the hospital only to return shortly after, coughing up bile-stained pus. This continued in varying degree for upwards of a year, the

case being considered to be one of suppurating hydatid cyst of the liver opening through the lung. Lastly, a perinephric abscess formed and was opened, the pus being again bile-stained, and the patient died exhausted a few weeks later. Postmortem, the liver was found riddled by suppuration. The bile-ducts were found very greatly dilated above some gall-stones and full of pus. On tracing up the dilated ducts a long probe could be passed from the common hepatic duct through the liver and diaphragm into an abscess in the base of the right lung and into the right bronchus. A direct communication could also be traced between the dilated hepatic duct and the perirenal abscess, while the scar of the empyema wound also led through the diaphragm down to another dilated pus-containing hepatic duct.

A case in which fistulæ from the gall-bladder led into the duodenum, the stomach, and the colon is recorded by Naunyn (p. 152).

There is a specimen in the Museum at Saint Bartholomew's Hospital which shews two fistulæ leading from the gall-bladder, one into the ileum the other into the colon.

Fistulæ between one part of the bile passages and another have been observed in eight cases. They are found between the gall-bladder and the hepatic duct (Ottiker and Fauconneau-Dufresne) or between the gall-bladder and the common duct (Schloth). Only a pathological interest attaches to these conditions.

CHAPTER VII.

PERFORATION OF THE GALL-BLADDER.

Gall-stones, in working their way through the walls of the gall-bladder, may give rise to various conditions. They may ulcerate through that wall of the gall-bladder that lies in contact with the liver and so come at last to lie in cavities in the liver substance entirely outside the gall-bladder, but communicating with it by the opening through which the stones have escaped. This is by no means an infrequent occurrence—one which may pass unnoticed when cholecystotomy is performed. If, however, cholecystectomy be attempted, it will then be found that what seemed on first examination to be nothing more than a greatly thickened gall-bladder is in reality a mass of inflammatory thickening around a fistulous track leading into the liver, in which one or many gall-stones may be found. In my first 20 cases of cholecystectomy I found no fewer than four in which stones had found their way through the gall-bladder wall into the substance of the liver.

Stones ulcerating through the surface of the gall-bladder clad with peritoneum may have their passage barred at the first by a mass of protective adhesions, which have been thrown out around the gall-bladder. In such circumstances a stone may have escaped entirely from the gall-bladder and be found in the centre of a

mass of organised lymph or of omental adhesions. If there should be an infection of this cavity, a localised abscess will form, but suppuration does not necessarily follow upon the perforation of the gall-bladder, for stones which lie in adherent masses of omentum may have caused therein no obvious signs of inflammation. In



FIG. 53.—Gall-bladder shewing stones in process of ulceration through the gall-bladder; one stone is seen to be almost through (from a successful case of cholecystotomy).

many recorded cases a “secondary gall-bladder” has been formed around gall-stones which have ulcerated through the walls of the gall-bladder into a mass of adhesions. Within this space stones may lie at rest for several years. Acute symptoms are, however, aroused either by the onset of a virulent infection or by the rupture of the secondary gall-bladder, or by the

detachment of any omental adhesion which has formed a part of its walls. The following case is recorded by Morton (Lancet, 1893, vol. 1, p. 586):

The patient was a female, aged sixty, who gave the following history: Two years before death the patient suffered from slight jaundice of about nine days' duration, without any colic. During the last year she had several attacks of severe abdominal pain, chiefly on the right side, with vomiting. She had never been jaundiced during the last two years. Neither had there been any ague-like paroxysms.

Postmortem.—The abdomen was distended, and on opening it much orange-coloured fluid escaped and general recent adhesive peritonitis was discovered. Just below the liver was a cavity the size of an orange, bounded above by the under surface of the liver and in front by the thin margin of the liver and the omentum which had been adherent to it. Below, it was separated from the colon by much thickened tissue. On its inner side lay the omentum, and on its outer side, covered by adhesions between the liver and adjacent parts, lay the gall-bladder, which opened into the cavity by an aperture which would admit one or two fingers. The wall of the gall-bladder was much thickened, and several stones half an inch in diameter were found lying in it. Where the omentum had before been adherent to the anterior edge of the liver, forming the anterior wall of the cavity, it had become detached, and thus the bile had escaped into the peritoneum and set up fatal peritonitis.

In the common duct, just where the cystic and hepatic ducts join, was another gall-stone, square or nearly so, and half an inch across in all directions. The wall of the duct around it was much thickened, but it did not



FIG. 54.—Gangrene of the gall-bladder with perforation. Two apertures are seen, through which stones escaped; at the lower left-hand corner a stone is seen presenting.

completely obstruct it, though there was very little space indeed for bile to flow by its side. The hepatic duct was much dilated; not so the cystic duct, which was much reduced in length and looked more like a foramen than a duct. There was no trace of jaundice postmortem.

Simon (Trans. Path. Soc., vol. 5, p. 156) quotes two cases from St. Thomas's Hospital where a process of discharge of stones from the gall-bladder had appeared to be in progress at the time of death. In one (whereof the specimen is preserved in the Museum) there was found, beyond the fundus of the gall-bladder, a cyst, constructed of dense cellular tissue, communicating with the gall-bladder by a small ulcerated opening and completely filled in its interior by a concretion of cholesterolin. In another of such transitional cases (Postmortem Book, 19 Oct., 1850) the fundus of the gall-bladder was found communicating, by an ulcerated opening a quarter of an inch in diameter, with a cyst, about as large as a pigeon's egg, formed of dense cellular tissue, coherent with the abdominal wall anteriorly and filled with irregular masses of concrete biliary matter and small calculi.

If a localised abscess should form, it may burrow extensively, and open, at its further end, on to the skin or into a hollow viscus. Stones ulcerating through the neck of the gall-bladder or the cystic duct may cause subphrenic or retro-peritoneal abscess, and the discharge of bile or of stones may then make clear the origin of the disease.

The gall-bladder when ulcerating may become ad-

herent to the stomach, duodenum, or colon, and the stone escapes into them through an internal biliary fistula.

Stones may ulcerate into the portal vein from the gall-bladder or any of the ducts. Four at least of such cases are recorded.

These, however, are all chronic manifestations of the perforation of the gall-bladder. In rarer cases the perforation may be acute, and the gall-bladder ruptures directly into the general peritoneal cavity. Of this acute perforation two forms may be met with; in the one the whole peritoneal cavity is at once invaded and a general peritonitis is caused; in the other, more common in traumatic than in calculous cases, the peritonitis, though almost equally severe, seems to be limited by the mesocolon and adherent omentum to the right hypochondrium; the bacilli in such cases have, no doubt, a slighter virulence. The symptoms of an acute perforation of the gall-bladder are those of peritonitis of a severe and rapid form, recognised in some as beginning in the right hypochondrium, but in many being so intense and widespread as to leave the point of its origin a matter of speculation.

The gall-bladder when examined is seen to present patches of ulceration upon its inner surface. There may be one large ulcer, similar, as Budd pointed out, in many of its attributes to the perforating ulcer of the stomach, or there may be several ulcers, one or more of them being almost gangrenous in appearance, and apparently ready at any moment to give way. The relief of tension in the gall-bladder as a result of the perforation has probably saved these from rupture. The outer



FIG. 55.—Same as Fig. 54, viewed from the mucous surface.

surface of the gall-bladder is maroon coloured or bright green, and shews a rent or a circular opening or, rarely, two or more openings. The peritoneal surface is covered more or less imperfectly with layers of ochre-coloured fibrin, which may be thick and tough, and almost of the appearance of wash-leather. The peritoneum around the gall-bladder is intensely inflamed, and upon all the coils of intestine in the neighbourhood layers of pale yellow fibrin are adherent. Bile is present, as a rule, in the peritoneal cavity, being absent only in those cases in which a stone occludes the cystic duct. Gall-stones may be found in the peritoneal cavity or in the gall-bladder or in both; there may be few or there may be hundreds. In five cases treated by operation a stone was found in a rent in the gall-bladder.

The rent or perforation, as a rule, is at the fundus of the gall-bladder, but any part of the wall may suffer. The edges are thin and ragged and torn.

Diagnosis.—A correct diagnosis has been made in certain cases by the observation of preceding phenomena of gall-stone disease. In cases recorded by Naunyn, Küster, and others, gall-stone colic had occurred. In one patient attacks of abdominal cramp had occurred and had been attributed to lead poisoning. In all cases the symptoms were ushered in by pain. The pain resembles, very nearly, that caused by the perforation of a gastric ulcer; indeed, in more cases than one such a perforation has been diagnosed. The pain is sudden in origin and is intense. It cannot often be localised, but is said to spread over the whole abdomen. Prostration, collapse, and vomiting speedily follow, and the

abdomen, at first rigid and tense, becomes distended, flatus ceases to pass, and the pulse becomes rapid, frequent, and perhaps irregular. After a few hours the patient may rally, having the "interval of repose" seen in all forms of perforation within the abdomen. Jaundice may appear, but is never deep in tinge. The abdominal distension increases progressively, and free fluid is discernible in the peritoneal cavity. In a case related by Schabad (Petersb. med. Woch., 1896) the patient lived twenty-five days after the time of the perforation of the gall-bladder. In traumatic rupture, where presumably the bile, in the absence of gall-stones, is sterile, the duration of life may be even greater than this. In St. Bartholomew's Hospital Museum there is a specimen (2268) of a gall-bladder ruptured by the impact of the abdomen against a piece of timber; the patient lived five weeks, dying from peritonitis. Mr. Arbuthnot Lane records a case (Lancet, March, 1894) in which operation five weeks after the rupture of the gall-bladder and the free escape of bile into the peritoneum was successfully performed.

Treatment.—Apart from operative treatment, the issue is always fatal. The earlier the operation, the greater will be the chances of success, though cases are related when life has been saved when the operation has been performed two and even three days after the catastrophe had occurred. Much will depend, of course, upon the virulence of the infection. The only bacteriological examination made up to the present is that recorded by Neck, the bacillus coli being the solitary organism found.

Mistaken diagnoses of perforated gastric ulcer, vol-

vulus, acute intestinal obstruction due to a band, and strangulated umbilical hernia have been made. One remarkable case is recorded by Kümmell in which a tumour supposed to be ovarian became acutely inflamed, peritonitis followed, and death in two days. The tumour was found to be a distended gall-bladder.

When the abdomen has been opened and the condition realised, the case must be treated on the ordinary surgical principles. All stones must be removed and the peritoneum cleansed. It may be necessary in certain cases to remove the gall-bladder; in other cases drainage alone will be indicated. Experience is too slender to permit of any definite rules being given.

It is clear that as soon as a perforation of the gall-bladder is diagnosed, operation should be undertaken, for the risks of septic infection increase with the lapse of time.

In the earlier stages bile itself has little infectivity, but with stagnation of the inflammatory exudation into the peritoneum, and increasing interference with the absorption of fluids, the culture medium becomes constantly improved and the bacteria acquire an increasing virulence. In all probability cholecystectomy followed by free drainage will prove to be the safest method of treatment.

Surgical treatment has been adopted in fifteen cases, including two of my own cases. The subject is so important and so little understood that a brief epitome of the recorded cases is given.

Case 1, operated on in 1881 by Schönborn, reported by Naunyn (Naunyn, *Klinik der Cholelithiasis*, p. 83) as follows:

F., fifty years, had suffered some months from severe gall-stone colic with icterus; stones not found. In one attack sudden abatement of the colicky pain, with severe collapse; some hours later most violent but now diffuse abdominal pain, severe vomiting, abdominal distension, rapidly increasing free peritoneal exudation. On the third day following Prof. Schönborn performed laparotomy at my request. An incision was made about 10 cm. long in the median line, between the umbilicus and the symphysis, and through this was evacuated a large quantity of slightly bile-stained serous pus. Drainage of abdominal cavity. After-course favourable, uninterrupted by any relapse. Patient lived eight years longer in good health, without any further symptoms of cholelithiasis.

Case 2.—(Küster, 1884, Congress der deutsch. Gesellschaft f. Chir., 1887.) F., aged fifty-seven. Patient had had several attacks of gall-stone colic, without discharge of stones being observed. On Nov. 26th (evening) violent diarrhoea with pain in neighbourhood of gall-bladder, increasing in severity. Small, rapid pulse; cold sweat on face and body; gall-bladder neighbourhood painful and tender on pressure. There was severe vomiting; morphia injections gave ease to the pain but did not produce sleep. Next midday pain became most violent, and distension and sensitiveness of abdomen were observed. In the afternoon of the next day the vomit was coloured brown, the pulse was weaker, there was slight icterus, and bile-pigment was seen in the urine. In the evening an enema was given without result; the vomiting continued and became fæculent.

The abdominal distension continued and increased. Lavage of stomach, which yielded evil-smelling brown fluid, gave some relief. Next day the condition was much the same, the pulse, which had been weak, increasing in tension. A second washing out of the stomach took

place and operation was then decided on. The diagnosis was not absolutely certain, though gall-bladder disease could hardly be doubted.

Operation: Nov. 29th. Abdomen opened in the middle line from ensiform process to umbilicus. Free bile was seen between reddened and distended coils of intestine, pointing to origin of the disease. By means of a transverse incision across the first incision the neighbourhood of liver was exposed, and the gall-bladder was found to be rather small; bile flowed away from the fundus. The opening was small and partly obstructed by a stone, which was plainly the cause of ulceration and rupture. The opening was widened, the stone removed, and the ulcerated wall cut away on every side into sound tissue. The gall-bladder remnant was then closed after careful cleansing with a double row of sutures of fine catgut. The abdominal cavity was most thoroughly cleansed, and the abdominal wound was closed with several rows of sutures. The effect of operation was but temporary, symptoms of peritonitis soon returning in their former severity. Death twenty-four hours after operation. No postmortem allowed.

Case 3.—(Jenner-Verrall, Brit. Med. Journal, 1897, ii, 341). The patient (F., forty-four) had frequently suffered from gall-stone colic with jaundice. For four days previously there had been frequent vomiting and pain in upper abdomen. Purgatives gave some relief, but the abdominal distension continued. "Facies peritonealis" present. There was a resistant area in neighbourhood of gall-bladder. An incision was made in the middle line of abdomen. Coils of intestine presented, covered with bile-stained fluid and fibrin. A perforation, about $\frac{3}{4}$ cm. in diameter, was found on the under surface of the gall-bladder. Gall-stones were found in bladder, and a large number removed. The cystic duct appeared free. No gall-stones were found in abdominal cavity. On

account of its friability, the gall-bladder was closed with great care by sutures which passed through all layers of wall. A second row of (Lembert's) sutures was passed over the first. All careful precautions as to drainage and plugging with gauze were taken. First stool passed thirty-six hours after operation. Gradual subsidence of abdominal distension and remission of fever. Patient discharged cured after forty-four days.

Case 4.—Allmann, 1897 (Allmann, Ueber Perforation der Gallenblase in die Bauchhöhle, Wiener med. Wochen., Nos. 25, 26, 1899). Patient, M., aged forty-two. There had been previous frequent attacks of colic which had been mistaken for lead colic. Another violent attack was experienced six days before the patient came into hospital. The abdomen was sensitive to pressure in neighbourhood of gall-bladder. An injection of morphia gave temporary relief. Next morning there were violent pain and slight collapse. Abdominal distension and constipation were present. Abdominal section was carried out forty-eight hours from beginning of illness. An incision was made parallel with the right costal arch, one fingersbreadth below it. The presenting intestines were distended and covered with somewhat viscid fluid and here and there with small clots. The gall-bladder was small and very shrivelled; on its anterior surface there was a perforation, the opening being about the size of a cherry kernel; in it the stone was fixed. No stones were found in the abdominal cavity. Cholecystectomy was performed. The cystic duct was ligatured and the peritoneum sutured over the stump. Abdominal cavity drained with strips of iodoform gauze, and the wound, except at the point where the iodoform gauze was projected, was sutured with three rows of stitches. In the evening patient's condition was fair; he vomited once in the evening and twice in night; hiccough was present the following morning. Abdomen

was much distended and most sensitive to pressure. The abdominal cavity was again opened, as it was clear that septic peritonitis was present, and some fluid which had collected in Douglas' pouch was mopped out. The patient died next morning. The gall-bladder was removed and found to be packed with stones, and a larger stone was found impacted in the cystic duct.

Case 5.—(Allmann, *loc. cit.*, 1897.) F., fifty-three. Suddenly attacked with violent pain in neighbourhood of liver, and repeated vomiting of yellowish material; jaundice not present. There had been two similar attacks previously. When the patient came into hospital she was suffering from dyspnoea and was without fever; the pulse was small and frequent; the abdomen was distended, on left especially. Palpation showed greater resistance in right hypochondrium, commencing within right mammary line, and especially under costal arch, with great sensitiveness to pressure. Percussion revealed dulness corresponding to area of resistance. A diagnosis of perforation of gall-bladder being made, laparotomy was performed. An incision was made from the ensiform cartilage parallel to the right costal margin. The peritoneum appeared everywhere inflamed, reddened, and covered with bile-stained, viscid fluid. The gall-bladder, nowhere adherent, was small and perforated. Nine gall-stones were found between coils of intestines. The abdominal cavity was cleansed with tampons, and the gall-bladder was sutured. The abdominal cavity was plugged with iodoform gauze in direction of gall-bladder, and drained with iodoform gauze in different directions. The abdomen was sutured up to the point from which the gauze projected. Next day the patient was better, but hiccough and abdominal distension persisted; on the day following the vomiting and hiccough ceased and the pulse was less rapid. On third day dis-

charge of flatus. All drainage ceased by seventeenth day; on twenty-fifth the patient discharged cured.

Case 6.—(Hochenegg, Ein Fall von Perforation der Gallenblase gegen die freie Bauchhöhle, geheilt durch Operation, Wiener klin. Wochen., No. 21, 1899.) F., forty-five. Patient admitted Jan. 26, 1899. Two days previously the patient had vomited after a heavy meal. The vomiting was violent, and the ejecta consisted of food and later of bile. Symptoms of illness not ascribed to presence of gall-stones. On Jan. 26th, after an energetic forward movement, there came on suddenly violent abdominal pain, collapse, and constantly increasing symptoms of peritonitis. These were followed by abdominal distension. Intestinal obstruction due to volvulus of sigmoid flexure was suspected. After some hours a tense swelling appeared, giving tympanitic percussion sound, and was regarded as a twisted coil of intestine. Temperature normal; pulse 96; diaphragm stationary; respiration frequent. There was an umbilical hernia which was for the most part reducible. Much sensitiveness in region of upper abdomen. The abdomen was opened in middle line; the transverse colon was seen to be enormously distended. In the attempt to free the omentum from it two litres of yellowish, viscid, bile-stained fluid escaped from the upper part of the abdomen. In the gall-bladder, at about the middle, was found a rent about 1 cm. long by $\frac{1}{2}$ cm. wide, partly blocked by a stone which was blackish brown in colour. From the perforation bile was slowly trickling; the gall-bladder was of normal size though the wall was thickened; it was not infiltrated with bile nor inflamed. The rent was sutured and a fresh opening made at the fundus. From here seven stones about size of hazelnut were removed. The abdominal cavity was cleansed and the fundus of the gall-bladder traced to the abdominal wall; a drainage-tube was inserted in the gall-bladder. Two

strips of iodoform gauze were introduced into abdominal cavity, and rest of laparotomy wound closed. After eight days the tampon was removed from abdominal cavity; after fourteen days, the drainage-tube. In another six days the gall-bladder fistula was closed. On thirty-second day patient discharged cured.

Case 7.—(König, Deut. med. Woch., 1902, No. 7.) A woman, until then healthy, was taken ill late one evening with internal pain and vomiting, etc. The stomach was found to be distended, sensitive to pressure, with painful swelling, the size of a hand, to right of umbilicus. Volvulus was suspected. On reception into hospital there were noted a rather wasted appearance, a foul tongue, and occasional sickness. Later, no sickness, but hiccough. No spontaneous passage of fæces; abdomen unevenly swollen, mostly on the right and somewhat beneath the umbilicus; here there was slight resistance. There was everywhere sensitiveness to pressure, and the peristaltic movement of intestines was neither visible nor audible. When the abdomen was opened in the middle line, an omental cord which proceeded from region of umbilicus to inner right inguinal ring was seen and was ligatured off. The fluid in abdomen was distinctly bile stained, and on extension of incision upwards over umbilicus blood coagula were visible on reddened intestinal loops, and in several places large dark gall-stones. The ascending colon was fixed by numerous old adhesions. The gall-bladder was found to be unusually large, lengthened, and thickened on its inner side; about two fingersbreadths from the fundus a rent was visible, surrounded by blood coagula; the opening was about the size of the tip of the finger, and was closed by a round brown gall-stone. A transverse incision was now made in the right rectus muscle. The gall-bladder contained several stones; the ducts were free from them. The general abdominal cavity was en-

tirely free of pus. The gall-bladder was separated from liver and removed with several stones. The abdominal cavity was cleared of gall-stones which lay near the rent, and the abdominal wound was closed without either drainage or tamponading. On second day after operation there was slight but distinct icterus. During the first two days the pulse (128) and the temperature (on one day up to 38° C.) were raised. Then both declined. Flatus passed on the day after operation. The wound healed without reaction so that patient got up at end of three weeks and could go home.

Case 8.—(Von Arx, Ueber Gallenblasenruptur in die freie Bauchhöhle, Correspondenzblatt f. Schweizer Aerzte, Nos. 19 and 20.) F., forty-eight. Patient had had some pain for eight months; there was a violent attack on March 23, 1902, and again another attack two months later; in both, cramp and vomiting; and in the last, constipation after severe diarrhœa. On May 14th the gall-bladder was palpable to below the umbilicus. Morphia and opium gave relief for one day. On May 15th, after a vain attempt at defæcation, the patient became aware of something suddenly giving way. There were alarming pain, meteorism, and vomiting. An injection of morphia was given. The tumour was no longer palpable. There was no jaundice. About twenty hours after the onset of perforation a median incision was made. There was a copious outflow of mucous bile with shreds of fibrin from abdominal cavity, and bile was seen between the coils of intestines which were injected, distended, and adherent. The gall-bladder was wholly collapsed, non-adherent, and its wall was thickened. Below, at the neck of bladder, was a perforation 2 cm. in length with necrotic edges; just behind it was found a stone the size of a nutmeg. The fundus was opened; the stone extracted. Freshening of superficial openings and suture of same. Abdominal cavity cleansed

with hot, sterile saline solution. Drain with tampon inserted in gall-bladder, which was sutured to the parietal peritoneum; an iodoform gauze drain was placed below the bladder. The patient recovered, and at the time of publication of this case the biliary fistula was completely closed.

The following case is recorded by Mr. G. P. Newbolt (Lancet, May 31, 1902, p. 1534):

Case 9.—A married woman, aged forty-eight, was seen on March 15th. She was very ill, and evidently had some grave abdominal lesion. She had suffered for some years from attacks of dyspepsia but had never had hæmatemesis or jaundice. For about a week before she had dyspepsia and for two nights had not slept on account of the pain referred to the umbilicus. During this time she had only taken a little liquid food. At 10 A. M. on March 15th she was seized with agonising pain at the umbilicus which caused her to double up and collapse. Three hours later the pulse was 110, feeble and compressible; the abdomen was not distended, but was hard like a board and tender all over, and her temperature was 102°. The liver dulness was present. The abdomen was opened in the middle line above the umbilicus. Yellow, turbid, serous fluid was seen amongst the coils of small intestine. Thorough examination of the stomach, back and front, revealed no perforation, and so it was distended with a pint of water passed by means of an œsophageal tube. The fluid did not escape. The incision was therefore enlarged down below the umbilicus. On introducing the hand into the right flank, a large gall-stone was felt in the cystic duct, and a much distended gall-bladder, adherent to the liver, which was enlarged. There was a minute hole in the gall-bladder from which thin, puriform fluid was escap-

ing. A transverse incision was made into the right loin; the gall-bladder was exposed and opened freely and six large stones were removed, one being impacted in the cystic duct. It was necessary to cut away the sloughing part of the gall-bladder, which was behind and to the inner side of the fundus; the edges were then inverted and sewn over, completely closing the cavity. Having thoroughly cleansed the abdominal cavity, a gauze pack was left in leading down to the gall-bladder, and the right flank was drained by placing a tube below the kidney. The patient stood the operation well and promised at first to make a good recovery; she sank, however, five days after the operation, apparently from exhaustion. There were troublesome vomiting and slight distension unrelieved by salines or enemata.

The following case is recorded by Lediard (Lancet, July 4, 1903, p. 21):

Case 10.—The patient was a female, aged forty-seven, who suffered from jaundice, fever, and tenderness in the region of the gall-bladder. Attacks of biliary colic had lasted on and off for three years, but generally yielded to hot applications and opium, and were not followed by jaundice, bile-stained urine, or chalky stools. When I first saw her, on March 26th, the abdomen was flat, but when I went to operate upon her gall-bladder a week later, the abdomen was swollen and a tumour of the size of an adult head existed in the middle line of the abdomen, the highest point of distension being rather below the umbilicus. It was clear that something had altered the appearance, and in consequence the incision planned was changed to a cut in the middle line over the swelling. On reaching the peritoneum, matted omentum and recent peritonitis were met with, and on passing the finger upwards towards the liver, a gush of thick

yellow bile escaped over the wound to the amount of some half a dozen ounces. On swabbing the discharge the upper surface of the liver was seen lying outside the gall-bladder. After the bile had been removed with swabs I enlarged the perforation with scissors and removed thirteen small gall-stones, packed the gall-bladder with gauze, and cleaned the abdomen. The perforation was invaginated and stitched with Lembert's sutures, one suture passing through the edge of the liver, owing to rottenness of the gall-bladder wall. The entire abdomen was now flushed out with salt solution, and the wound was then closed absolutely. The patient suffered from shock and had a subnormal temperature for a few days and was fed rectally for some five days, but made a good recovery.

The three following cases are recorded by Neck; the notes of the last two having been sent to him by Wiegel of Nuremberg:

Case 11.—F., forty-two. Patient admitted on August 28, 1902. The illness had begun with gastric catarrh, vomiting, and finally severe and general abdominal pain. Umbilicus distended and very painful. Peritonitis was present. The diagnosis lay between strangulated umbilical hernia and disease of gall-bladder. The patient had suffered from general malaise and vomiting for three days, and also from pain below the right costal arch and about the umbilicus. On the morning before her admission her pain became suddenly worse; it extended all over the abdomen, which was much distended. Respiration became rapid, and there were all the signs of a sudden peritonitis. It was probable that there was some affection of the gall-bladder, but an absolutely certain diagnosis was not possible, owing to the presence of a

small umbilical hernia which might prove to be strangulated. These were the circumstances that led to the abdomen being opened in the middle line. As nothing was found in the hernial sac, the gall-bladder was examined, and disease of the gall-bladder was indicated by the presence of the peculiar mucous (though not bile-pigmented) pus, coming from the right side of the abdomen.

Operation: The abdomen was opened in middle line by an incision commencing at ensiform process and terminating 5 cm. below umbilicus. An umbilical hernia about size of plum was opened. Neither intestine nor omentum was found in the hernia sac, but muco-purulent fluid in large quantity was evacuated from right side of abdomen. The presenting coils of intestine were all reddened and markedly distended; on some coils to the right were seen fibrinous layers in patches. By means of an oblique incision above the umbilicus taking a course parallel to the right costal arch, the region of the gall-bladder was laid open. It was here specially, between the intestinal coils of the right side of the abdomen, that the mucous pus was present. The gall-bladder was not increased in size; at the fundus there was a perforation of the diameter of a pea; its edges were thin and irregular. The lower surface of liver as well as part of stomach was covered with fibrin. From the orifice of the gall-bladder only a little pus was evacuated.

The abdominal cavity was cleared of the muco-purulent contents as far as possible by sponging; no gall-stones were found in it. The gall-bladder was isolated by gauze compresses, and the opening already present in it was slightly enlarged after it had been found, by sounding, that there were gall-stones present in the bladder. No stone was seen in the perforation opening. Twelve facettèd gall-stones, size of hazelnut, were

extracted. No flow of bile. Mucous membrane much swollen, coloured dark-red, showing ulcers at several points. An attempt was made to stitch the gall-bladder to the abdominal wall, but owing to the friability of the walls the stitches cut through. A tube was introduced into the gall-bladder and the wound was left unsutured. The patient slowly recovered, bile ceasing to flow from the wound at the end of the fifth week.

Case 12.—M., forty-five years old, who had had for years numerous attacks of gall-stone colic, and on this account was treated medically in different ways. Patient had also visited Carlsbad. On August 22d he had severe tearing pain in right side of abdomen. After this, severe pain over the whole abdomen set in. The pulse was very small and rapid. Perforation of gall-bladder was suspected. Dr. Wiegel was called in to operate. The pulse was rapid and small. The abdomen was as hard as a board and very sensitive to touch.

In the abdominal cavity was a quantity of blood, partly coagulated, partly fresh. Between the intestinal loops were numerous gall-stones. The gall-bladder was enormously enlarged—to about the size of a goose's egg. On the side of it, adjoining the under surface of the liver, was a rent about 6 cm. long which had passed through the whole wall of the gall-bladder. The tear was bleeding severely. Hæmorrhage was stayed by pressure. Afterwards the gall-bladder was opened in the fundus. After opening it was found to be filled with coagulated blood. All the stones and blood clots were evacuated from the abdominal cavity, and gall-stones were removed from the gall-bladder and cystic duct. Afterwards the gall-bladder was packed with gauze, and the fundus of the gall-bladder was sewn to the abdominal wound. A drainage-tube was inserted and the abdominal wound was partially closed by suture. Saline infusion. After the operation the pulse rose a little. On the next

day general condition was bad; towards evening signs of peritoneal irritation set in. Death followed on August 25th, with symptoms of peritonitis.

Case 13.—F., aged forty-two. Patient stated she had suffered from "catarrh of stomach" three years previously. For some years past had had pain nightly in right side of abdomen. Present illness (1903) commenced with severe rigor at midday, lasting two hours. Towards evening violent pain set in on right side of abdomen. Some jaundice supervened, varying in amount. Stools regular. On September 5th, sudden accession of pain in great severity. Jaundice increased and pain became general over abdomen during next five days, up to reception of patient into hospital. Stools ceased two days before admission. Flatus was not passed, and vomiting, which became faecal in odour, set in.

The usual signs of peritonitis were predominant, the abdomen becoming tense, distended, and sensitive to touch, especially so beneath right costal arch. Abdominal dulness from free effusion. No tumour palpated. Respiration hurried. Pulse 126 per minute and small. Temperature 38°.

Three hours after admission, abdominal section, under chloroform, incision being made from umbilicus to symphysis pubis. Bile-stained fluid evacuated. Incision therefore prolonged upwards over umbilicus. Above umbilicus transverse incision to right made. Large quantity of bile-stained fluid welled up everywhere between coils of intestine. Gall-bladder could not be located. In ductus choledochus was felt round hard body about size of cherry (gall-stone).

On account of patient's bad condition radical operation not undertaken, iodoform gauze strips being inserted in abdominal cavity. Abdominal wound closed by suture in middle line. Opening made for drainage

in right lumbar region. Saline infusion injected and camphor administered subcutaneously every two hours. Next day pulse stronger, but more frequent (126). Vomiting ceased, but distension still persisted.

Change of bandage on September 13, as bandages were soaked with bile. Abdomen still distended and sensitive to touch. One attack of vomiting, and for first time, still of liquid consistency and whitish-grey colour.

Plugging changed September 16th. General improvement in condition from this date up to October 8th, when general symptoms of gall-stone colic (violent pain, rigor, vomiting, etc.) returned with accession of icterus. Attacks continued to October 13th.

Operation undertaken under chloroform for attempt to remove stone impacted in ductus choledochus. Granulations of wounds pared off. Wounds wiped with iodoform tincture. Rectangular incision made, one side of which reached from middle line above umbilicus to the right as far as prolongation of anterior axillary line; the other took a course downwards to the centre of abdomen. Triangular flap thus formed folded back, and adhesions between parietal peritoneum, omentum, colon, liver, and stomach detached. Between stomach and liver was found layer of tissue about 1 mm. in thickness, which might have been either organised pseudomembrane or remnant of degenerated gall-bladder. On pressure with blunt instrument inwards, clear bile fluid was evacuated from this region. Layer of tissue above mentioned was removed. At lower surface of liver, portion of tissue of similar appearance remained behind. Gall-bladder could not be located with certainty. After stomach had been detached from liver it was possible partially to unfold ligamentum gastrohepaticum (lesser omentum), and by separating the adhesions behind it to introduce finger-tip into bursa omentalis. Round hard stone, size of cherry, in chole-

dochus was now felt; it was easily movable, now slipping behind duodenum, now upwards to ductus hepaticus. It was finally fixed and cut down upon. Incision of about 3 cm. had to be made. After removal of stone abundant flow of bile. India-rubber tube introduced into hepatic duct, over which the choledochus wound was closed, up to point of exit of tube, by means of thread and catgut suture. Plugging with iodoform gauze around drainage-tube.

Towards evening there was secretion of bile in larger quantity through drainage-tube. Patient vomited but once after operation, and then no more. Secretion of bile through drainage-tube gradually diminished and then ceased. Patient left hospital with abdominal bandage and free from discomfort on November 26th.

Case 14.—The following case was recorded by me in the British Medical Journal, November 8, 1902:

Phlegmonous Cholecystitis: Perforation of Gall-bladder.—M. A., aged forty-six; male. Patient seen with Dr. Erskine Stuart, Batley. Had been perfectly well up to December 31, 1900. On that day he had a sharp attack of pain in the right hypochondriac region about an hour after his evening meal. He felt sick and cold, vomited several times, and could only obtain ease by doubling himself over the back of a chair. He was given a large dose of opium and put to bed. The next day he was slightly jaundiced; the day following more so, and the jaundice has persisted. Pain in the right hypochondrium has been constant—relief had only been obtained by opium administrations.

On examination, January 11, 1901, the patient was found moderately jaundiced and looking ill. The abdomen was full and prominent; the whole right hypochondriac region was hard, strongly resisting, tender

on pressure. The muscular protection was so effective that no deep examination was possible. A diagnosis of cholangitis and cholecystitis, depending possibly upon calculus, was made. The rigidity and tenderness were supposed to be due to a localised peritonitis, possibly dependent upon distension of the gall-bladder as a result of obstruction of the cystic duct.

The abdomen was opened on January 12th by an incision through the right rectus muscle. On opening the peritoneum bile-stained liquid with flocculent masses of lymph flowed from the wound. At the least three pints of fluid were removed. A collection was found between the liver and the diaphragm, the fluid there being thick and semi-purulent. An examination of the gall-bladder disclosed the cause of the condition. The gall-bladder was thickly coated with lymph, was deep purple in colour, and showed a sloughing opening on its surface from which bile-tinged fluid was oozing. The opening was about one and a quarter inches in diameter; its edges were ragged and a little thickened. In the gall-bladder seven stones were found; an eighth, the largest, was discovered later in the upper part of the renal pouch, partly buried in lymph. The cavity was cleaned up as well as possible, the gall-bladder opening trimmed, and a drainage-tube secured in it; the sub-phrenic abscess was separately drained and a tube was also passed in through a stab wound in the loin.

The patient, whose condition was bad before the operation, died, gradually declining in forty-eight hours.

Many cases of **chronic perforation of the gall-bladder**, with abscess, have been recorded. As a rule, the abscess cavity lies between the gall-bladder and the abdominal wall, and it is only after the evacuation of the pus that

gall-stones are found and a rent in the gall-bladder discovered.

The following interesting case is recorded by Wendel (*Annals of Surgery*, vol. 27, p. 199):

The patient, a woman, twenty-three years of age, had an extremely movable ovoid tumour in the upper part of the mesogastric and left lumbar regions; the lump was five inches in length and three inches in breadth; it was clearly cystic. The patient was seen on several occasions, and on each the tumour was found in a different position in the abdomen. After nine months a tender swelling was found in the right hypochondrium. There had been a sudden seizure of severe pain in the right iliac region, faintness, vomiting, high fever, and abdominal distension. Operation was declined, and the patient gradually recovered from her serious condition, but six months later she consented to operation on account of the distress caused by the lump in her side. An incision was made in the right semilunar line, over the most prominent part of the swelling. As the knife penetrated the thickened peritoneum, pus welled up freely, the opening was enlarged, and several ounces of stinking pus and several gall-stones were evacuated. The finger defined an abscess-cavity communicating with the gall-bladder, which had a perforation about one inch in length and one-half inch in breadth on the postero-external aspect of its body. The viscus was filled with gall-stones. The gall-bladder was loosened from the adhesions, a portion of the adherent omentum tied off and removed. The cystic duct was found to be one-eighth inch in diameter, three and a quarter inches in length from the anterior border of the liver to the neck, and very much twisted. The peritoneal investment of the duct presented a mesenteric development

about two inches in length, which was attached to the inferior surface of the liver. The neck of the gall-bladder was obstructed by the largest of the concretions.

The duct was divided at the anterior border of the liver, inverted, closed with a fine catgut suture; the peritoneum was finally closed over the stump. The sac contained 213 gall-stones.

I have operated upon the following case:

The patient was a female, aged thirty-nine, who was admitted to the Infirmary under my care. She had suffered for years from attacks of pain accompanied by vomiting and soreness of the body. There had never been jaundice nor any symptoms which were attributed to gall-stones. Hæmatemesis was said to have been observed on two occasions. While in the Infirmary she was seized with an acute attack of pain with rigor, a temperature of 104° , collapse, and vomiting. The abdomen was a little distended and there were exquisite tenderness and rigidity over the gall-bladder area. Her condition improved rapidly, but a stiffness of the abdomen remained. The upper part of the right rectus was rigid for the four days which intervened between this attack and the operation. I opened the abdomen through the right rectus and found the gall-bladder inflamed and adherent. On separating the omentum from its inner side an abscess cavity about the size of a hen's egg was disclosed, and in this five small gall-stones were lying. The opening into the gall-bladder would admit a lead pencil. It was near the fundus. I enlarged the opening and trimmed its edges. Over sixty stones were removed from the gall-bladder. A drainage-tube was introduced into the gall-bladder and a separate gauze-drain was placed in the abscess cavity. The patient made a speedy recovery.

CHAPTER VIII.

INTESTINAL OBSTRUCTION DUE TO GALL-STONES.

The obstruction of the intestine by a gall-stone is an infrequent occurrence. At the Leeds General Infirmary, where probably more cases of gall-stones are operated upon than in any other British hospital, we have had only one case during the last ten years.

Barnard (*Annals of Surgery*, August, 1902) found that during eight consecutive years 360 cases of intestinal obstruction were operated upon at the London Hospital; among these were eight examples of gall-stone ileus. The proportion of cases of obstruction due to gall-stones to other forms is said by Fitz to be 1 to 13, by Leichtenstern, 1 to 28. The average age of patients is from fifty-five to sixty years, and women are affected five times more frequently than men, the youngest being twenty-seven (*Path. Soc. Trans.*, vol. 1, p. 255). In 120 cases observed by Naunyn, five patients were under thirty, seven between thirty and forty, and ninety-six between forty-one and sixty. The gall-stone which causes the obstruction may ulcerate through the gall-bladder into the stomach, very rarely (Jeafferson, *British Medical Journal*, May 30, 1868), the duodenum; most commonly, the jejunum or the colon. Cysto-duodenal fistulæ are more frequent than all other forms of gall-bladder fistulæ. Naunyn, in 30 fatal cases, found a duodenal per-

foration in 28, and a perforation into the colon in the remaining two. The passage of a stone from the gall-bladder into the duodenum is obviously more likely to cause obstruction than the passage into the colon. In rare cases the gall-stone may have passed down the common duct, which is then considerably dilated. Such a case is recorded by Abercrombie, who says: "The common duct was enlarged so as easily to admit a finger." (Diseases of the Stomach, etc., p. 134.) The following brief notice is recorded by Lynn Thomas:

"A gall-stone passed through the common bile-duct without giving rise to obstruction, and got impacted in the ileum about one yard from the ileo-cæcal valve, and caused death from obstruction within three days. I got it through an insurance company questioning the cause of death of a man who was struck on his right side whilst getting into a dogcart through his horse running away; slight umbilical pain came on at once, and passed off for a short time, to recur and develop within twenty-four hours into a case of acute intestinal obstruction. I made the ne-



FIG. 56.—Two large and articulated calculi which were passed naturally. The larger measured one and a half inches in extreme diameter, and weighed 250 grains; it has a second facet, indicating the presence of a third calculus. From a lady, aged forty, who recovered after seventeen days' symptoms of intestinal obstruction. She lived fourteen years afterwards (Royal College of Surgeons' Museum, No. 2830 d).

cropsy nine years ago; no operation had been performed. The stone is remarkable as being conico-cylindrical in shape, like a pom-pom shell; it is one and five-eighths inches in diameter and its point had travelled in front. There were no adhesions around the gall-bladder and bile-duct."

Leichtenstern and other writers have recorded cases of blockage of the bowel by concretions which consisted of a gall-stone nucleus and a laminar deposit of salts. The very great majority of gall-stones which cause obstruction have passed through a fistulous communication between the gall-bladder and the duodenum. The stone may obstruct the duodenum, the jejunum, the ileum, the sigmoid flexure, rarely the colon. The small intestine from the duodeno-jejunal angle to the ileo-cæcal valve gradually narrows in calibre. A stone therefore which causes obstruction high up in the jejunum will be, as a rule, larger than a stone which blocks the ileum near its termination.

If a stone, therefore, escapes from the duodenum, it will most probably be arrested near the ileo-cæcal valve. In 32 cases quoted by Leichtenstern the stone was found in the duodenum or jejunum in 10 cases, in the middle ileum in 5 cases, in the lower part of the ileum in 17 cases.

Courvoisier found the obstruction in the duodenum and jejunum in 21.4 per cent. of cases; in the ileum in 65.4 per cent.; at the ileo-cæcal valve in 10 per cent.; and in the sigmoid flexure in 2.4 per cent. In rare instances the stone may cause symptoms of obstruction by becoming impacted in the colon (Körte, Berl. klin. Woch., 1893, p. 690) or in the sigmoid flexure.

The obstruction in the majority of instances is due to the actual plugging of the bowel by the calculus. When the gut is opened, the stone seems to lie upon a sort of diaphragm which is caused by the sudden narrowing of the gut at the lower margin of the stone, for the bowel below the obstruction is generally quite flaccid, thin, and empty. It would seem that in exceptional instances a volvulus may be due directly or indirectly to the blocking of the intestine by a gall-stone. The following instances are recorded by Mayo Robson (Trans. Royal Med.-Chir. Soc., 1895, p. 117):

Case 1.—"Acute intestinal obstruction in a woman of sixty-eight; operated on November 12, 1890, by laparotomy. On the eighth day of the obstruction a volvulus of the small intestine was discovered and untwisted. Bowels moved by enema on the sixteenth day after onset of obstruction and eighth day after operation, and a large gall-stone, three inches in circumference and one and three-eighth inches long, was passed, this being manifestly the cause of the obstruction and secondarily of the volvulus. The patient returned home on the twenty-sixth day and remained quite well when heard of a year subsequently."

Case 2.—"On March 13, 1894, I received a telegram asking me to go prepared to operate on a case of acute intestinal obstruction. I found a Mrs. O., aged sixty-two, suffering from acute obstruction of six and fæcal vomiting of two days' duration, the onset having started like a gall-stone attack, with pain over the gall-bladder, and later in the umbilical region. She gave a history of having suffered from attacks of gall-stones for several years, some of which had been followed by jaundice; and from the mode of onset of the present seizure, and

the slight jaundice following it, she was quite sure the attack had been one of her old seizures at the commencement. From the persistence of the fæcal vomiting, the presence of visible intestinal peristalsis, and the pinched and anxious countenance, with the absence of relief by ordinary medical means, operation was decided upon. Laparotomy was performed, and volvulus of the small intestine being found, the loop of gut, which was much congested, was untwisted and the abdomen closed. Flatus passed the same day and the bowels were opened the next. The wound healed by first intention and recovery was uninterrupted."

The following remarkable example of impaction of a stone in the duodenum is recorded by Meisel (*Münch. med. Woch.*, 1900, No. 7). A woman, forty-three years of age, had suffered for three months with signs of dilatation of the stomach and pyloric stenosis. When the stomach was washed out, remnants of food taken eight days before were found. Wasting, acute pain, more especially after food, and vomiting were the chief symptoms, and a large movable tumour was felt by the patient herself through her lax abdominal wall. The abdomen was opened under the expectation of finding a carcinomatous growth at the pylorus. The tumour was found to be due to a large gall-stone impacted in the beginning of the duodenum. Mikulicz (*Archiv f. klin. Chir.*, Bd. 51) found that duodenal obstruction in one case was due to the pressure of gall-stones lying in a diverticulum from the cystic duct. Several stones were superimposed and their pressure had greatly narrowed the lumen of the duodenum.

The narrowest part of the bowel from the pylorus to the anus is at the ileo-cæcal valve. The valve may cause the arrest of a stone, or may be ruptured or damaged by its passage. Thus Maclagan (*Trans. Clin. Soc.*, vol. 21, p. 87) records a case in which a woman, after four attacks of intestinal obstruction, passed spontaneously four large gall-stones, each one inch in diameter, and at the postmortem only the fringes of the ileo-cæcal valve remained. It would appear that the gall-stone may, by the irritation of its rough surface, induce a spasm of the bowel, and thus cause intestinal blocking, for Duplay and Reclus state that on postmortem examination the stone has often been found lying quite loose in the flaccid intestine. Israel has recorded a case of obturation due to a gall-stone whose largest diameter was barely three-quarters of an inch; muscular spasm was considered a potent factor causing the obstruction. The conditions present in a case of gall-stone ileus differ from those present in most cases of intestinal obstruction. There is a block in the lumen of the bowel, but there is no interference with the circulation. The experiments of Kader have shewn clearly that the intensity and severity of the symptoms of strangulation are in no small measure due to the interference with the vascular supply of the involved loop. In gall-stone ileus we have to reckon only with a plugging of the lumen.

SYMPTOMS.

The symptoms of intestinal obstruction due to gall-stones vary within the widest possible limits. They are

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most intense and of greatest urgency in those cases in which the duodenum is blocked or the upper part of the jejunum; they are subdued and of the type present in chronic intestinal obstruction when the sigmoid flexure is affected, or when, as in one case related by Ord, the stone is caught in the rectum just above the internal sphincter. In the majority of cases the stone is impacted in the ileum and a definite clinical picture can, therefore, be drawn to illustrate the average case.

A history of previous attacks of gall-stone colic may be obtained, but generally there is no mention made of jaundice as one of the symptoms. The stone, as we have seen, generally makes its way through the wall of the gall-bladder directly into the duodenum; there is no interference with the free passage of bile, and, as a rule, there is no cholangitis. In only about one-fifth of the recorded cases, so far as my reading goes, was an undoubted history of regular cholelithiasis obtained before or after the operation.

The onset of symptoms is usually abrupt. There is a sudden seizure of acute abdominal pain, attended either by faintness or nausea. Vomiting occurs soon, increases quickly, both in quantity and frequency, and is, in all cases, the most conspicuous and the most distressing symptom. The character of the ejected fluids alters in appearance every few hours. At first the vomit is green, deeply bile stained, and contains a little mucus. Soon it becomes turbid, dark-yellow or brownish in colour, and has a faint, sickly smell. Within twenty-four hours there is an unmistakable sour, offensive, almost fæculent odour, and shortly afterwards the vomit

is recognised as consisting of the contents of the small intestine, and is usually described as being stercoraceous. Schüller found that "fæcal vomiting" was present in 77 out of 120 cases. The vomiting is decidedly more severe when the obstruction is high in the jejunum, and is then unremitting and exhausting. When the block is lower, there are less distress and less urgency. The quantity of fluid that may be ejected is astonishingly large. Dr. Pye Smith has related a case in which, when the upper jejunum was blocked, ten pints were vomited within forty-eight hours.

After the initial shock has passed off, the symptoms, apart from the vomiting, are by no means so intense as in other forms of small intestine obstruction. The pain is generally slight and continuous, but there are often intense, though transient, exacerbations. During these attacks of colic there may be faintness and collapse. In most cases the obstruction is not at once complete. Flatus is passed once or twice and the bowels may act. Naunyn emphasises the fact that flatus may be passed even at the time that the vomiting is stercoraceous. Rarely a loose motion may be discharged, or there may be a brisk attack of diarrhoea. Obstruction, with the passage of flatus in small quantity, once or twice, is the rule. Abdominal distension is rarely present. The greater number of the patients are women over fifty years of age, in whom the abdomen is fat, flabby, and pendulous. Palpation reveals a soft, unresisting abdomen. Intestinal coils are seen only in the chronic cases. A very good example of this is recorded by Elsner (*Med. News*, February, 1898, p. 167). There is little

or no tenderness on examination. In rare instances the stone has been felt through the abdominal wall or on rectal examination. (Eve, *Brit. Med. Journ.*, 1895, vol. 1.)

In a typical case of gall-stone ileus, in which the stone is impacted in the ileum, the following will be the characteristic signs and symptoms: The patient is generally a woman, over fifty years of age, and of full habit of body; the onset of symptoms is sudden; pain and slight collapse are first observed, and very speedily, vomiting; vomiting is incessant, copious, and exhausting; it is the most striking feature of the case; the ejected fluids become stercoraceous in about twenty-four to thirty-six hours; obstruction is often incomplete, flatus or even fæces being occasionally passed; rarely, there is diarrhoea. The abdomen remains, as a rule, soft and flaccid.

Though this is the type, the variations from it are not seldom encountered. The following illustrative cases may be quoted:

Elsner (*Med. News*, 1898, p. 164) records the case of a woman, fifty-seven years of age, who consulted him in March, 1895, on account of repeated acute pains in the upper part of the abdomen. There was a history of gall-stone colic with jaundice. From March until July progressive emaciation and anorexia were observed; there were repeated attacks of pain, but no calculi were observed in the stools. On July 5th a hard swelling "about the size of a hazelnut was palpable near the border of the epigastric and right hypochondriac regions." A diagnosis of pyloric carcinoma was made. There

was constant indigestion and the stomach was very dilated. Free HCl was absent on all occasions. This condition persisted until October, 1896, a period of fifteen months from the discovery of the tumour, which was always palpable. In this month symptoms of partial intestinal obstruction were manifested and the tumour had disappeared. On October 8th there was observed a "characteristic coiling of a portion of the intestine into a sausage-shaped mass in the upper part of the abdomen." There was vomiting of a dirty green, at times brown coloured, sour-smelling fluid. A few days later a tumour was found in front of the tense intestine, and was equal in size to the tumour formerly palpable in the epigastric region. A diagnosis of gall-stone obstruction was then made. On October 14th the coiling seemed to involve the whole length of the small intestine. The increase in coiling seemed to justify a delay in instituting surgical interference. I concluded that obstruction was not complete, and that the obstructing mass was movable, as shewn by the increased length of the intestine involved from day to day. On October 16th a gall-stone was passed; it measured five and a half inches in circumference, three inches in length, and its weight was 368 grains. Eleven months later, after an attack of "acute indigestion," a second gall-stone was passed, weighing 240 grains and measuring three inches in circumference. Since the passage of the second gall-stone the patient had remained quite well.

This case illustrates several interesting points: The error in the diagnosis of the tumour felt in the position of the pylorus; the discovery that the "tumour" was wandering; the intestinal distension which was recognised as increasing day by day, and finally the safe passage of so large a stone. Somewhat similar instances

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are related by Miles (*Lancet*, 1861), Hale White (*Brit. Med. Journ.*, vol. 2, p. 903, 1886), and other writers.

In other recorded cases the symptoms of obstruction have recurred, owing to the blockage of the gut by other stones. Such an instance is recorded by Maclagan (*Clin. Soc. Trans.*, vol. 21, p. 87):

The patient, a lady of spare habit, sixty-three years of age, was seized on February 14th with a severe attack of pain in the abdomen, accompanied by much sickness and nausea. The vomiting was peculiar, the ejected matter exceeding in quantity anything that could have been lodging in the stomach; it came up without any effort in large quantities and evidently consisted of the contents of the small intestine. The acute symptoms lasted five days and then passed off. On March 4th a similar attack occurred. There was intense griping pain in the abdomen; intense nausea and occasional vomiting were present. This attack passed away, and on March 21st another attack began, characterised by the same symptoms—vomiting, constipation, and acute pain. On April 1st there was a fourth attack; on April 18th she passed a large gall-stone, nearly an inch in diameter; on the following morning a second, a little over an inch in diameter; the next day she passed a third, and two days after, a fourth. The patient gradually became weaker and died. At the postmortem a free communication was found between the gall-bladder and the duodenum. The cystic duct was obliterated. Dr. Maclagan sums up as follows: "It will be observed that the illness which this patient had consisted of four distinct attacks, characterised by acute pain in the abdomen, sickness, nausea, and the occasional ejection by the mouth of the contents of the small intestine. During each attack the bowels ceased to act. There

can be little doubt that these four attacks correspond to, and were symptomatic of, the passage down the small intestine of the four gall-stones which she subsequently voided."

The symptoms in some few recorded examples have approached in indolence and quietude those due to chronic intestinal obstruction. The following case is recorded by Everley Taylor (*Lancet*, 1895, vol. 1, p. 867):

The patient, a woman fifty-six years of age, had been suffering from continuous vomiting for thirty-six hours when first seen. On examination, a rounded swelling, slightly movable and dull on percussion, was noticed. For the first two days after treatment, morphine, dieting, etc., was begun; the vomiting continued incessantly. For the next five days all food was stopped. During this time there was no retching or nausea, and flatus was passed. On the twenty-sixth day the abdomen became distended, no flatus passed, and the vomiting for the first time became stercoraceous. Operation was decided upon; the abdomen was opened and a gall-stone found in the small intestine and removed.

Dr. Wilkinson gives brief notes of a case under his own care (Mayo Robson: "Diseases of the Gall-bladder," etc., 2d ed., p. 101):

"My patient is a lady of sixty-three, and the facts are briefly: An attack of acute intestinal obstruction, stercoraceous vomiting, etc. Obstruction lasted three weeks, giving way finally under rest, opium, and copious enemata; and three weeks later a gall-stone was passed,

per vias naturales, about the size of a pigeon's egg, and weighing five drachms four and a half grains."

PROGNOSIS.

It is certain that a spontaneous recovery may be anticipated far more frequently in cases of gall-stone ileus than in any other form of acute intestinal obstruction. Even when the patient has been ill for days and is brought perilously near to death, recovery may ensue when the stone is passed. Hutchinson (Archives of Surgery, 1892, p. 9) gives notes of a case in which the symptoms were of such severity that on the sixth day all hope of recovery was abandoned, and it was expected that the patient would die in the night. The following morning, however, improvement set in, a gall-stone was voided, and complete recovery followed. Other similar instances have been related. At times the symptoms may be acute, the pain and incessant vomiting most distressing till a moment when, quite suddenly, ease is experienced and recovery is assured. It is not difficult to believe that at such a time the stone escapes through the ileo-cæcal valve into the more capacious large intestine, presently to be passed by the rectum.

The frequency with which an attack of acute obstruction, due to gall-stones, passes off with complete recovery has been variously estimated. Naunyn considers that over 50 per cent. of patients recover under the expectant treatment—morphine, enemata, etc. He mentions that in a series of thirteen operations only one terminated successfully. He further points out that frequently the

obstruction yields after seven or nine days, and concludes that operation is not to be recommended. Langenbuch remarks that "Gall-stone obstruction is a surgical disease, the treatment of which is to be entrusted to the physician only during a very short period."

The various museums contain very large stones which have been safely passed, and side by side with these may sometimes be seen smaller stones which have caused fatal obstruction. Fitz (quoted by Hemmeter: "Diseases of the Intestines," vol. 2, p. 236) collected notes of 23 cases of gall-stone obstruction. Twelve were treated medically, of whom eight recovered, and eleven surgically, of whom two recovered. The passage of the gall-stone in those cases which recovered occurred on the fourth, fifth, sixth, tenth, fourteenth, fifteenth, seventeenth, and twentieth days. Since all the cases operated upon after the seventh day terminated fatally, and as five cases under medical treatment after this date recovered, Fitz is of the opinion that the condition of the patient must chiefly determine the treatment to be followed. There can be no doubt, however, that in many patients, as is abundantly confirmed by the reading of recorded cases, operation is only advised when prolonged medical treatment has proved unavailing. Under such conditions it is not surprising to find that the bowel has been found gangrenous at the point of blockage or above it, and the general intestinal congestion and distension above the stone of the most marked degree. The operation is then only a last resort in a case in which death was certain and imminent.

If a sure diagnosis of gall-stone obstruction could be

made, a delay of two or three days, during which medical treatment was being tried, would, in some cases, permit of the passage of the stone. There are, however, very few cases recorded in which the stone was passed before the fourth day. It is certain that the best results would be obtained if a series of cases could be treated upon the ordinary principles now governing the treatment of all forms of acute intestinal obstruction—operation at the earliest possible moment after the diagnosis of acute obstruction has been definitely made. If the abdomen is opened in a case of gall-stone ileus, the operation is frequently of extreme simplicity, and is rapidly performed. The gall-stone is easily found, removed by a simple incision, and the resulting wound, barely more than an inch in length, can be securely stitched up in less than five minutes. The whole operation need not occupy more than twenty to thirty minutes. The shock is therefore slight, the peritoneal handling trivial, and the exposure of the intestines of the briefest.

Operations performed during the first three days would probably have a mortality little, if at all, in excess of 10 per cent.

TREATMENT.

If medical treatment be advised, it will consist chiefly in withholding food by the mouth, in the administration of nutrient enemata hourly, and aperient enemata once daily, and in the injection of small doses of morphine and atropine subcutaneously. The constant vomiting may be relieved by occasional lavage of the stomach.

If operation be advised, it will be carried out with the precautions and preparations necessary in all abdominal operations. An incision just large enough to admit the hand is made between the umbilicus and pubes. When the peritoneum is opened, the cæcum is sought and the terminal portion of the ileum. This will probably be found collapsed. The empty gut is rapidly passed through the finger till the stone is met. The loop containing the stone is then withdrawn from the abdomen, clamped above and below, or nipped by an assistant's fingers. The stone is then removed by an incision down on to it through the intestinal wall, the cut being of such length as the size of the stone demands. If the bowel below the stone be very empty and narrow, the stone may be displaced upwards two or three inches, into a distended portion of the gut, to make the subsequent suture of the bowel easier. The stone being extracted, the incision is stitched by two layers of continuous sutures, the bowel cleansed and replaced, and the operation completed in the usual manner.

The gall-stone may be pushed onwards into the large intestine in certain cases, as in the following, recorded by Clutton:

A woman, aged seventy-six, passed a large gall-stone per anum with symptoms of cholelithiasis, including jaundice. After these symptoms had subsided a tumour could be felt in the position of the gall-bladder, but the patient remained well for fifteen months, when she was suddenly seized with severe abdominal pain, vomiting, and other symptoms of acute intestinal obstruc-

tion. The tumour in the region of the gall-bladder was found on examination to have vanished, and the true cause of the obstruction was suspected. Laparotomy was performed and a conical concretion was found about eight inches from the lower end of the ileum, which was pushed on through the ileo-cæcal valve without much difficulty. Five days later it was passed per anum, after some trouble with the rectum, and was found to consist of a gall-stone one and a quarter inches (3.1 cm.) long by one inch (2.5 cm.) broad, and three and three-tenth inches (8.25 cm.) in circumference. It had one large facet which fitted to that on the calculus passed fifteen months previously.

The successful result in this case was due mostly to the fact that the operation was undertaken only twenty-four hours after the onset of the acute symptoms, by which time the gut around the stone had hardly had time to become much injured. The manipulation of the stone was also rendered more easy by its narrower end lying nearer the valve than the broad end.

C. L. Gibson, in a study of 646 cases of intestinal obstruction recorded between 1888 and 1898, found that 40 were due to gall-stones (*Annals of Surgery*, October, 1900, p. 506); of the 40 cases, 21 died. There were 9 males and 27 females; in the remainder the sex is not mentioned. The youngest patient was thirty-five years of age; only seven patients were under fifty, and eight were seventy years or over.

The obstruction was only once found below the ileo-cæcal valve; once the stone was impacted in the valve. In 21 cases the history distinctly states the site of its

arrest as the ileum; in two, as the jejunum, and in one at the junction of jejunum and ileum.

There was a clear history of gall-stones in 18 cases; in five cases it is distinctly stated that there had never been any suspicion of cholelithiasis.

The largest stone weighed three and a half ounces.

CHAPTER IX.

DETAILS OF PREPARATION FOR OPERATIONS UPON PATIENTS SUFFERING FROM GALL-STONES.

Success in abdominal surgery, as in all the affairs of life, depends very largely upon the observance of details. In the careful examination of the patient, with reference both to the local and to the general conditions; in the strict preparation for a few days before the operation, whenever possible; in neatness, rapidity, and thoughtful planning of the operation—in all these there lie the means and the secret of success. With few exceptions, the same technique is desirable in all operations. I propose to describe the details which are carried out in my own operations, *first*, with reference to the surgeon, assistants, nurses, instruments, and dressings, and, *secondly*, with reference to the patient.

PREPARATIONS ADOPTED BY THE SURGEONS AND ASSISTANTS.

It is most desirable, it is even more, it is absolutely necessary, that for the proper observance of cleanliness during operations the surgeon should be properly clad. The garments which are suitable for daily wear are surgically unclean and should be changed by all those who are in immediate proximity to the area of opera-

tion. In former days the surgeon felt that he was adequately prepared for an operation when he had perfunctorily turned back the cuff of his coat, and in the



FIG. 57.—Surgeon prepared for operation.

illustrations of all the older works on surgery (borrowed and reproduced, it is sad to say, even up to the present) the surgeon's cuffs and links are neatly depicted. The

removal of the coat and the wearing of a special coat—generally an old-fashioned and almost worn-out overcoat—were considered a striking improvement. Such a garment was worn from day to day, and becoming more and more stiffened by freshly added splashes of blood, was as disreputable and as greatly prized as the dilapidated gown of an undergraduate. I can still recall the thrill of excitement and the murmur of amusement that greeted the appearance of the first white operation coat in my own hospital. To-day, however, the surgeon should be clad from head to foot in spotless sterilised garments. A sterilised cap is worn so that the heads of the surgeon and his assistant when they meet in sharp contact over the abdominal wound shall not scatter hair and dirt broadcast. A sterile coat is worn, sterile sleeves, and boiled rubber gloves. Sterilised, or, at least, newly washed white trousers and clean shoes, preferably with rubber soles, are worn. Prepared in this way the surgeon is safe not to inflict a chance infection in any wound. All parts likely to be near the wound or to touch it are absolutely clean.

It is not enough, though one can see the practice every day, to wash the hands and perhaps the forearms and to be content with this. When instruments are lying on a towel during the performance of an operation, the surgeon may, in some manipulation, allow an unclean elbow or arm to rest for a few moments upon an instrument, and presently employ that instrument again. The operator should be so prepared that all his accessible surfaces are clothed with sterile garments. Exactly the same rules apply to the assistants and the nurses.

There should be no uncovered surfaces, which, by contact, are likely to cause infection.

Hands.—The preparation of the hands should be the same whether gloves are worn or not. It is almost impossible to over-emphasise the importance of thorough cleansing of the hands and nails. The literature of this one subject alone would require almost a life-time for the reading, but the conclusions of all investigators are unanimous in stating that an assured and absolute sterilisation of the hands is impossible to obtain. But there can be no question that a sufficiently near approach to perfection can be attained by the exercise of the greatest care. Professor Kocher, for example, whose results are at the least the equal of any, operates with bare hands. But of the care taken by him to ensure cleanliness, all those who have seen him work or who have read his book will realise. It could, I think, be successfully argued that of all the details in the preparation for an operation none equals that of the cleansing of the surgeon's hand.

The preparation begins with a thorough washing in soap and hot water. When the hands and arms are socially clean, a nail-brush may be taken and a thorough scrubbing of the hands, fingers, and nails especially, is begun. Each finger and each nail separately scrubbed and frequent rinsing in water as hot as can be borne is necessary. If possible, running water should be used, but failing that, a series of basins will do equally well. After prolonged washing in one basin, a second is used, and a third, and finally a fourth. Each basin and the water which it contains should be sterilised. It is of

no advantage to have sterile running water if the basin into which it runs is a fixed basin, which cannot be rendered sterile; nor is it possible to have water remain sterile if the basin in which it fills is fixed as in the ordinary lavatory. Either the water must be running continuously and allowed to flow over and away from the hands and arms, or the basin and its contained water must each be easily sterilisable. The washing must be carried out regardless of time. After at least fifteen minutes of soap and water the hands and nails may be scrubbed with sterile gauze, which is worked into all the crevices and cracks which exist on every hand and finger. After this some antiseptic application is necessary. The best is alcohol in some form or another. Eighty per cent. of alcohol to the extent of two or four ounces may be poured over the hands, rubbed well over, and wiped off with a sterile towel, or the hands may be soaked for a few minutes in a solution of spirit and biniodide of mercury. Instead of alcohol a watery solution of biniodide of mercury 1 : 2000 may be used, and the hands, forearms, and elbows allowed to soak therein for at least five minutes by the clock. The great disadvantage of all antiseptic preparations for the hands is the undoubted tendency that they have to cause roughness. This rough and coarse condition of the skin makes any cleansing very much more tedious and any reasonable sterilisation very difficult of attainment. In these matters the personal idiosyncrasy of the surgeon goes for much. Some operators can bear mercury compounds, others are immune to the irritation of carbolic, but all, so far as I can judge, can bear to use alcohol

preparations better than any other antiseptic agent. My own practice is to wash thoroughly in the way I have described, with soap and hot water, to use gauze friction, to steep for a few minutes in 1:2000 biniodide, then to have a wash over with alcohol, and finally to rinse well in sterile salt solution.

Gloves.—It is now my invariable practice to use rubber gloves during operations. At the first I found some difficulty in working in them, and I felt clumsy and inapt. That was the fault of the gloves, and of my want of knowledge of the proper method of putting them on.

I now use $7\frac{1}{2}$ light rubber gloves. They are a size smaller than my ordinary glove, and therefore fit fairly tight. After being boiled for twenty minutes they are put on in the following way: The opening in the glove is held stretched wide by two fingers and the glove is filled, by a movement of "scooping," with sterile salt solution which fills the basin in which the gloves lie. When the glove is nearly filled with water it is held in one hand while the other hand gently wriggles into it. As the hand enters, water escapes until the fingers have reached to within about an inch of the tip. Then the other glove is filled and put on in exactly the same way. The further pulling on of the gloves is impossible, but they may be made to go on by rapidly stroking the glove from the fingers to the wrist with dry sterile gauze. The glove when fully on should fit quite tight, but should not be so tight as to hamper the movements of the hand. The outside of the glove should never be touched with the opposite hand, which, though scrupulously

prepared, should be considered, as it doubtless is, capable of infecting the glove if friction be used. (See Kocher's *Operative Surgery*, second English edition.)

During an operation the glove-covered hand is rinsed in sterile salt solution as soon as soiled. As a rule, it is easier to work with a glove which is wet than with one which is dry, for when dry, the gloves are apt to stick to instruments, ligatures, and swabs. A frequent rinsing in a sterilised solution is therefore necessary. No antiseptic solution is ever used, and none is permitted to touch the peritoneum. There is abundant experimental evidence to shew that the delicate peritoneum is seriously damaged by contact with antiseptic solutions, and that its power of absorption is decidedly lessened.

During an operation a glove may be pricked or torn by a needle or other sharp instrument. This is more likely to happen when the operator is unused to gloves; as he becomes more accustomed to them and has cultivated a slightly altered tactile sense, he will find that an injury to a glove is rarely caused. If the prick be on a finger, a finger stall or a finger cut from another glove which has been partially spoilt must be used to cover the damage. This should be done at once, for if the glove has been worn even for a few minutes, the hand will be septic. The sweat glands and the deeper portions of the skin will have emptied their organisms on to the surface of the hand. If a rent be made in the hand of the glove, a fresh glove must be put on at once. It is, therefore, always necessary to have a reserve pair of gloves, for the surgeon and for his assistant, and several glove fingers.

At the first using of the gloves the operator will doubtless feel that his fingers are clumsy, and that it is difficult to get a proper grip of any structure. A little practice, however, will soon overcome all these initial difficulties. If a flat gauze swab be used on the gloved hand, it will be found that a better hold is thereby obtained than is possible with the bare hand. A pattern of glove has recently been sold in which the surface of the rubber is roughened by the impress of innumerable fine pits. In use, however, I have not found any advantage from this.

Assistants.—The remarks made as to the preparation of the surgeon apply also to his assistant. As a rule, only one assistant is necessary or desirable. Indeed, many operations, such, for example, as gastro-enterostomy, can be done without any assistance. A good, well-trained assistant is, however, a great help. More assistants than one are rarely, if ever, necessary, and each one is an additional potential source of infection. The fewer persons engaged in an operation the fewer are the chances of infection. The nurse or nurses immediately engaged in the operation are instructed to prepare in the same manner as the surgeon. A white sterilised dress or overall is worn, the hair is covered with a sterile cap, and clean white rubber shoes are worn. If a nurse helps in the operation by handing swabs or sponges, or by cutting ligatures, threading needles, or the like, she should prepare her hands as does the surgeon and should wear rubber gloves. In these circumstances she becomes an additional assistant, and if the same nurse be employed over a series of months

or years, she will soon become expert in her work, and scrupulous in the preparation for it.

Swabs.—Swabs are employed for all operations. I have ceased to use marine sponges for several years; they are more difficult and more tedious to prepare, and are not so trustworthy. The large flat sponge certainly answered its purpose, the protection and covering of the viscera, rather better than any flat swab I have used, but the difference is only slight and is more than compensated, in my opinion, by the greater sense of security that one has in regard to the sterility of a gauze swab.

Swabs are made entirely of gauze or butter muslin. I prefer the latter. The swabs are of various sizes from three inches square to six inches square, and are made by folding over two or three times a large square of gauze. The frayed ends of the gauze are tucked in, so that no loose filaments are left on the wound when the swab is used.

The large flat swabs are made of several layers of muslin, and are quilted at the edge in order to prevent fraying. At the corner of each a piece of tape eighteen inches in length is stitched. This ensures that no swab is left in the abdomen. The whole of the gauze square can be introduced and the tape left hanging from the wound, a clip being fastened on the end. This method is the most satisfactory of all, for if no tape be affixed, the sponge or swab must be kept in sight, or a portion of it must project from the wound, and the space in which the surgeon has to work is thereby greatly narrowed.

The small swabs are put up, for sterilising purposes, in packages of two dozen, the large ones in packages of half a dozen. The number of each size used is counted at the completion of the operation so as to make certain that none has been left in the abdomen. My own rule is never under any circumstances or in any operation to allow a small swab to be left even for a moment in the cavity—a small swab is not allowed to leave the hand of the surgeon or his assistant; the large swabs are introduced in any number, but a clip is at once applied to each tape, or to a group of two, three, or more tapes. The counting of the swabs under these conditions is not necessary, but it is as well to observe the ceremony, as it impresses upon all concerned the importance of being exact in such matters.

The swabs, after being made in the manner described, are packed in a hold-all made of gamgee tissue, protected on the outer side by brown holland. The number in each package is always the same—two dozen of the smaller sizes, half a dozen of the larger size. In these packages the swabs are sterilised, three or four of the hold-alls being wrapped together in a strong large towel. The sterilisation is effected in a pressure steriliser, a temperature of 250° C. being maintained for forty to sixty minutes.

It is important that as short an interval as possible should elapse between the sterilisation and the usage of the swabs. The most desirable, though not always the most convenient, arrangement is for the process of sterilisation to conclude within an hour of the operation, and for the packages to be taken from the steriliser

forthwith to the operation room. But if this cannot be done, it is most desirable that the interval should not be more than one or, at the most, two days. After a longer period than this it is desirable to repeat the sterilisation. The same rules and procedure apply to the towels used during the operation. There should be an abundance of these, used to cover in the patient completely. These should be sterile, and their sterilisation should have been recently completed.

Instruments and Ligatures.—Everything used by the surgeon or by the nurses engaged in the operation should be sterilised. Bowls, ligature, and instrument dishes, jugs for saline solution, and similar articles should all be boiled. These are often large and even cumbersome in size and their sterilisation by boiling is not easily effected. I have a large copper vat, measuring two feet by two feet by two feet, into which all bowls necessary for any operation are placed and therein boiled for thirty to forty minutes. If the operation should prove to be a septic one, as in appendix or tubal or gall-bladder operations, especial care is subsequently taken that all bowls, etc., are subjected to prolonged boiling. The washing out of such basins with strong antiseptic solutions may be soothing to the conscience of the surgeon or of the nurse, but it probably does not much affect the power of procreation of a pyogenic organism. Prolonged boiling is necessary.

Catgut.—For some years now I have used catgut prepared by a method I described in the *Lancet* (vol. 2, 1902, p. 1486). I have found the method most satisfactory, and

I have long ceased to have any anxiety whatever about the sterility of the catgut in any operation.

The following is the process:

For the boiling, an enamelled pan is used. In this about one and a half pints of water are boiled. While the water boils ammonium sulphate is gradually thrown into the water. To obtain a concentrated solution about a pound of ammonium sulphate is used. When this concentrated solution boils, the catgut is introduced and allowed to remain for fifteen minutes. With sterile forceps the reels are then lifted out, washed thoroughly in boiled or boiling water, and placed in the following solution: iodoform, one part; ether, six parts, and absolute alcohol, fourteen parts. The catgut improves with keeping up to about six or eight weeks. The solution of ammonium sulphate boils at 128° C. The catgut may be kept in it for an hour without being softened, but fifteen or twenty minutes at a temperature of 128° C. are sufficient to insure sterility. The rinsing of the catgut in boiled water is necessary to remove the excess of salt, which otherwise crystallises on the catgut and on the glass. The solution splashes a little while boiling. If the xylol process of preparing catgut is used, the metal receiver may be boiled in this solution instead of in water, and the temperature of the xylol thus raised well above 100° C.

Recently I have used catgut prepared by the method of Claudius. The preparation is simple, the catgut is easy to handle, and its sterility is absolute.

Catgut is used for almost all ligatures. If anything stronger is needed, then *Pagenstecher's celluloid thread* is used. This is made in several sizes, but the thin and a

medium size are all that are necessary. I use this material for all sutures that are required to be long-enduring, and for all sutures that require to be retained in place for more than a few days. The use of silk has been entirely abandoned by me for some years, as I find that the celluloid thread is more easily sterilised, that it presents a smoother surface, and that it is far stronger than an equal size of silk. The breaking of a Pagenstecher thread ligature or suture is an extremely rare occurrence; when it happens, it is almost certainly due to the fact that the thread has been boiled too often. The thread when wound on glass reels can be boiled for four or five operations, but after this it begins to fray and is then liable to break. It is, moreover, then most unsuitable for sutures, for the rough surface tears the peritoneum as it is being pulled through. This is the only fault that the thread has, and as the thread is very cheap, it is better to throw it away after being boiled three or four times than to run any risk of its breaking.

Drainage Material.—During recent years a marked change has come over surgical opinion with regard to the question of drainage after abdominal section. At one time it was considered that drainage was the safeguard after all operations; that the provision for the free escape of inflammatory products made up for any slight fault in the operative technique. Now, thanks largely to the work of Clark and others who have studied the question with great care, we know that when employed as a routine measure drainage is rather a means of sepsis than a measure of escape from its effects. Drainage of the peritoneal cavity is very rarely necessary. The point will be dealt

with again when we come to speak of the various operations; but, speaking generally, one may say that it is only for septic conditions that drainage is ever needed.

The best drain in the majority of cases is gauze. It absorbs well and conducts fluids away better than any other material. Its only disadvantages are that after remaining in the abdomen for a few days it is prone to become offensive, and its removal is difficult. In order to overcome the latter difficulty the gauze may be surrounded by a rubber tube or by dental rubber. The two forms of drain which prove most satisfactory in general use are (1) the split rubber tube with gauze wick, and (2) the so-called "cigarette drain."

The split rubber tube may be of any size; as a rule, the larger the tube, up to a diameter of seven-eighths of an inch, the better. The tube is cut of adequate length, and a slit is made along it with scissors; in it a wick of gauze is then laid, to fit loosely in the lumen of the tube and to project for a couple of inches from each end. The gauze wick at one end of the tube is then carefully laid in position within the abdomen, and if necessary either the gauze or the end of the tube may be fixed in position by a single catgut suture. This is especially necessary when the drain is needed at the upper part of the abdomen, as, for example, after cholecystectomy. The movements of the diaphragm, and the consequent up-and-down movements of the liver, are apt to displace the gauze or to roll it up into a ball which blocks the end of the tube. If fixed with a stitch, this will not occur; the stitch being of catgut, softens within five to eight days and the tube can then be removed. The *cigarette drain* is made in the

following manner: A piece of dental rubber, well boiled, is cut, about ten inches square. Over this a four-fold layer of gauze of the same size is placed. The edge of the two squares is then turned over about one-fourth of an inch, and again over, and then rolled onwards until a cylinder of gauze and rubber is formed. A section of this cylinder shews a series of layers, alternately gauze and rubber, lying one within another. It is as though there were a series of rubber tubes, of gradually lessening size, each with its own wick of gauze, one within another. The terminal edge of the roll may be fixed with a stitch or with chloroform, a little gauze being turned in so that the edge of the outer rubber can be opposed to the underlying rubber and there fastened. This drain may also conveniently be fixed in any desired position with a suture of catgut. In cases of subphrenic abscess or of localised perforation of the gall-bladder where the cavity to be drained is often extremely foul, the cigarette drain may be made slightly antiseptic by dusting a thick layer of powdered boracic acid, with or without a little iodoform, over the gauze before the rolling-up is begun. Such a drain is best made at the moment it is needed. The ordinary form can be made some time before the operation, and sterilised just before usage. As a rule, however, I make the drain when I find that I want it, the materials for it being always ready to hand.

PREPARATION OF THE PATIENT.

In all cases an adequate preparation of the patient is most necessary. There are certain surgical emergencies,

catastrophes like the perforation of a gastric or a duodenal ulcer or the rupture of a tubal gestation, in which the urgency of affairs does not permit any elaborate detail to be observed. But whenever time and circumstance and opportunity render it possible, the preparation of the patient, both locally and generally, should be most scrupulously observed. It is said by some surgeons that strict preparations are absurd, but there can be no question that they repay one in better results. The patient should be kept in bed for the whole of the day preceding operation, and for the afternoon and evening of the day before that. If the operation is to be done on say Wednesday morning, the patient goes to bed on Monday afternoon. He is at once given five grains of calomel, which is followed early on the Tuesday morning by a full dose of saline aperient. Later in the morning, if these have not acted, an enema of soap and water is given, and if the bowels are at all loaded or the patient has previously suffered from constipation, the enema is repeated late at night. The condition of the *mouth* receives close attention. Every patient is given a new tooth-brush and a bottle of antiseptic mouth-wash on arrival in the nursing home or hospital, and the nurse is instructed to see that a thorough cleansing of the mouth is observed every hour or two during the day. It is astonishing to what a degree of uncleanness even the better class of people will allow their teeth to go. Patients with gastric ulcer and its complications seem to suffer especially from bad teeth, and, indeed, the point is worth raising as to the degree in which oral sepsis may be a factor in the causation of gastric ulcer. If the patient is in

very feeble health, the nurse is instructed to clean the patient's mouth by frequent wiping with gauze or lint, and the patient subsequently rinses the mouth out. It is possible, as the excellent work of Dr. Harvey Cushing has shewn, by careful attention to the condition of the mouth and by the sterilisation of all foods, to render the alimentary canal comparatively aseptic. All patients from the moment they are received into hospital are fed on fluid diet, and everything given is sterilised, and the feeder or vessel from which the food is taken is also boiled.

I am disposed to think that the occurrence of parotitis and of pneumonia after abdominal operations are both largely, if not solely, due to infection from the mouth. In some cases so foul a condition of teeth and gums may be accidentally discovered as to make a little delay in operating imperative. In one patient I found quite by accident a degree of suppuration in the mouth and a foetor of breath that warranted a diagnosis of Riggs's disease. In such a case, and even in bad cases of carious teeth, an aspiration pneumonia is not unlikely to occur, or an extension of inflammation up Stenson's duct, unless a thorough and repeated cleansing is observed.

The skin of the abdomen needs, and must receive, very careful preparation. The hair is first shaved away from the whole abdominal wall and from the pubes. It is evidence of careless work to see a patch only shaved, one half of the pubic hair, for instance, remaining untouched. It is well to limit the operative field, of course, but the preparation of the skin must extend wide beyond it.

A free washing with soap and hot water frequently changed is first necessary. The best material wherewith

to wash is sterile gauze in large pads. These are moistened with hot water and rubbed with soap till a good lather is obtained. This washing should be continued for a quarter of an hour, the water and the gauze being frequently changed. An antiseptic compress is then applied and left on for twenty to twenty-four hours, or until the movements of the patient begin to displace it. The compress consists of lint of two or three thicknesses, soaked in one per cent. formalin, 1 in 60 carbolic, or 1 in 2000 biniodide lotion. I prefer the former, in the belief that there is by its means a deeper penetration of the skin and of the glands.

At the end of twenty-four hours there is a second washing, and a second similar compress is applied. This is removed immediately before the operation, when a third cleansing is made. The skin is now rubbed with spiritus saponatus—a solution of soap in spirit—a swab wet with 1:1000 biniodide solution being used to make a fine lather. This is wiped away with biniodide lotion and finally the skin is wiped over with sterile salt solution.

Some patients' skins are very tender and will not bear this preparation. If not, the second washing is omitted, for it is supremely important that the skin should not be roughened or chapped, and that any irritative rash should not be caused. Overpreparation to the extent of damaging the skin is almost as bad as no preparation at all. If there are any small furuncles or septic cracks on the skin within the operation area, these must be carefully disinfected. The only satisfactory method of doing so is by means of the actual cautery, the point of the hot metal being kept in contact with the infected spot until all the

septic matter is destroyed. When it is realised that the yellow spot in a furuncle may contain a pure culture of the *staphylococcus pyogenes aureus*, the complete annihilation of such a colony is seen to be a desirable thing.

If the skin of the patient should be very rough, scaly, chapped, or cracked, its adequate preparation is almost impossible. In these conditions the "rubber dam" introduced by Dr. J. B. Murphy of Chicago will be found of the greatest service. It consists of a strong, very adhesive material, which is stretched and then placed on the abdominal wall, to which it clings most closely, becoming, in fact, for the time, an inseparable part of this wall.

Through it the incision is made, and the hand lying outside, or any viscus escaping from the abdomen, lies not upon the abdominal wall, but upon this sterile rubber dam.

As a general rule, no more preparations than those indicated are necessary, but in some few the general condition of the patient may be so enfeebled that special precautions are needed. It is a matter of the highest importance in all cases to ensure that the heart and the kidneys are acting well. Inefficient kidneys are among the most serious obstacles to success in any major operations, but especially in any abdominal operations. A routine and most exact examination of the urine for two or three days is, therefore, necessary. If the patient be feeble, or the heart so weak as to be a cause of anxiety, much good may be done by hypodermic injections of strychnine and digitaline for a few days before the operation. Five minims of the liquor strychninæ may be

given three or four times daily. If the patient has been accustomed to alcohol, his usual quantity may be allowed him. All patients who are submitted to any abdominal operations are clothed in a suit of gamgee pajamas made for them by the nurse. After being made, of appropriate size, the suit is well warmed and is put on a few hours before the beginning of the operation. It is worn until all risk from the operation is past, and is then removed limb by limb.

OPERATION.

The operation, if possible, should be performed in a room specially furnished for the purpose. In a public hospital a well-equipped operation theatre is always provided. In a nursing home or in a private house it is sometimes necessary to operate in the patient's bedroom. The advantage of this is that it is less of an ordeal to the patient, who is sometimes alarmed at the prospect of being taken to a special room, and that there is less of lifting or of carrying after the operation. These trivial advantages are, however, greatly outweighed by the disadvantages, which are, that in the conversion of a bedroom into a theatre there is much traffic, many tables, instruments, etc., having to be taken into the room; that it is not possible to have all the needed appliances to hand with the same certainty, and that finally the smell of the anæsthetic clings to the room for many hours. An ordinary room in a nursing home can readily be converted into, and equipped as, an operation room, to the great convenience of the surgeon. The operation

table should have the foot towards the light, and should be of good height. Many of the tables are about three inches too low. If the table is high, it is more convenient and more comfortable for the surgeon, and if, for any brief manipulation, it is necessary for the surgeon to be at a rather high level, a plain metal or wooden footstool can be used.

AFTER-TREATMENT.

No small portion of the success in all abdominal operations depends upon the after-treatment. When the patient is returned to bed, she is generally propped up slightly, by three, four, or five pillows. If a drainage-tube is left in the wound, its outer end is fitted into a bottle of about ten ounces capacity, which is fixed by a safety pin to the side of the dressing. During the first few hours bile may flow in very small quantity, especially in cases where the action of the hepatic cells has been in part suppressed by the tension and sepsis in the common and hepatic ducts, as a result of the occlusion of the duct by a stone. The bile that first flows may be muddy or turbid, but after a few days the bile flows in greater quantity and it becomes gradually clearer. The patient is allowed no sip of water until the ether sickness and the feeling of nausea are over. In all cases the abdominal bandage is applied tightly, so that if vomiting should occur, the wound may thereby receive some support. If thirst is great, the mouth may be flushed frequently with water or soda water, and an enema of salt solution, from ten ounces to twenty ounces in quantity, may be given. If the pain is severe, ten grains of aspirin may be given

by the mouth, or twenty grains by the rectum. Morphia is never given during the first twenty-four hours and very rarely, indeed, afterwards. In some cases, especially in old and enfeebled patients who have slept but little or not at all during the first night, and who do not seem likely to sleep during the second night, a small dose of morphia, one-sixth of a grain for example, may safely be given if the patient is otherwise in a satisfactory condition. On the third or on the fourth night it may be given under like circumstances. A good night's rest often is a great help to a patient who is enfeebled by a long-enduring disease and distressed by the anxiety of a serious operation. Under these rare circumstances, therefore, morphia may be given, but it must not be repeated.

Saline injections, about six ounces every four hours, are given for the first two or three days. If the pulse is poor or the patient at all collapsed, an occasional hypodermic of five or ten minims of liquor strychninæ is given.

As soon as the sickness is over a few teaspoonfuls of fluid are given by the mouth. Water, or tea made to the patient's liking, is the best; on the second day milk and soups may be given; on the third the same, with milk puddings and a little bread and butter.

The condition of the mouth receives constant attention. The teeth are cleansed three or four times a day by the patient or by the nurse, and a wash of some weak and fragrant antiseptic is frequently employed.

Drainage-tubes are left in until the stitch which fixes them loosens spontaneously. This occurs about the

seventh to the tenth day. The tube is removed and the wound is then dressed daily. While the tube is still in the wound it is not necessary to change the dressings unless they are soiled by leakage of bile by the side of the tube. If gauze packing is employed, it may be left from four to eight days. The stitches are removed about the eighth day.

If the patient is old and feeble, she is allowed to sit up out of bed within three or four days. In all such cases through and through stitches will have been employed, and there is consequently little or no risk of damage to the wound.

CHAPTER X.

OPERATIONS UPON THE GALL-BLADDER AND BILE-DUCTS.

HISTORICAL.

The history of the surgery of the bile passages is full of interest. Langenbuch, in a paper read before the German Congress of Surgeons in 1896, has given a detailed account of the various steps by which the treatment by surgical methods of cholelithiasis and of its many complications has been laboriously built up; and in the following account I have borrowed freely from his paper.

The first record of the removal of a gall-stone from a living patient is found in the year 1618, the operator being Fabricius Hildanus. In 1630 Zambecari, an Italian, performed cholecystectomy upon a dog. The animal recovered, and two months later was killed. At the examination it was found that the omentum and bowels were adherent over the stump of the cystic duct. In 1667 a student, Teckof, in Leyden, removed the gall-bladder from several dogs. Ettmüller, referring to the work of Teckof, says: "As we now know, the gall-bladder can be removed from dogs without detriment to life or health. I was first informed briefly of this by a friend who told me that a student of Leipzig had removed the gall-bladder from a dog three months before, and had closed the abdominal wound at once. This animal still lives and fulfils all the functions of life without the least disturbance."

Further experimental work was done by Malpighi,

Taubrin, and others and by Seeger, by whom it was shewn that ligature of the cystic duct gave rise to hydrops of the gall-bladder.

Gall-stones were removed by operations performed, in 1687, by Stalpart van der Wiel; in 1738 by Amyand, and in 1742 by Müller. These operations were in all cases the result of accident, rather than deliberately planned and purposeful operations.

The first surgeon who carefully devised and deliberately carried out an operation for the removal of gall-stones was Jean Louis Petit, in 1743. His procedure was limited to those cases in which it was thought that the gall-bladder was adherent to the abdominal wall. This adhesion was diagnosed when a tumour of the gall-bladder was present which was not movable from side to side, or when an inflammation over the gall-bladder seemed on the point of bursting through the skin. In one case certainly, the patient being a woman, he operated with success at several sittings. He writes: "How many people have died because this disease was not recognised, or because no operator could be found who would undertake to rid them of their disease by means of an operation!"

Petit's work was, however, ignored by many of his contemporaries and successors, though it was recognised by Haller, and operations were performed by Morand and Sharp.

Herlin, in 1767, performed a number of experiments upon dogs and found, as Teckof before him had found, that the gall-bladder could be safely removed. He advised extirpation of the gall-bladder as a remedy for cholelithiasis.

The next advance was made by Bloch of Berlin in 1774, who attempted to create an artificial adhesion of the gall-bladder to the parietal peritoneum by means of the application of irritant materials to the skin. In three cases he operated successfully.

August Gottlieb Richter, the famous German surgeon, first suggested that adhesion of the gall-bladder to the parietal peritoneum was not an essential preliminary to an operation. He wrote: "Is then an escape of bile into the belly cavity to be feared when the gall-bladder is not adherent to the peritoneum if the trocar be used, and be left in the wound after the gall-bladder is empty? Have we not cause to hope that the cannula will cause the gall-bladder to adhere to the peritoneum, preventing it from moving away by the creation of adhesions?" As a step further than this may be mentioned the procedure adopted by Sebastian, Carré, and Fauconneau-Dufresne, in which the abdominal wall was incised down to the parietal peritoneum, and into the wound irritating substances were placed to promote adhesions. Kocher in 1878 opened the abdomen and packed around the gall-bladder with Lister's gauze, and six days later, when adhesions had formed, he opened the gall-bladder and emptied it; the patient recovered completely.

The next advance is due to Thudichum, who, in 1859, suggested that the operation of cholecystotomy should be performed in two stages, the gall-bladder being stitched to the abdominal wound in the first stage, and in the second, the gall-bladder being opened. The advocacy of this method, however, found no favour, and for eight years there is no record of any operations having been performed upon the gall-bladder or the bile passages.

In the year 1867 Bobbs, an American surgeon, performed cholecystotomy in one stage. After opening the abdomen the gall-bladder was brought up into the abdominal wound, opened and emptied, and then sutured to the parietal peritoneum. The operation was based upon an inaccurate diagnosis; it was thought that a large fluctuating tumour was an ovarian cyst; on exploration it proved to be a dropsical gall-bladder. This operation attracted so little contemporary notice that several

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operators, Daly (Lancet, 1876), Maunders (Brit. Med. Journ., 1876), Handfield Jones (Med. Times and Gazette, 1878), Brown (Brit. Med. Journ., 1878) all believed that their methods were original. In 1877 Marion Sims and Keen performed cholecystotomy after the method employed by Bobbs. Marion Sims' patient suffered from calculous obstruction of the common duct, and died of hæmorrhage. The credit of performing the first intentional and successful cholecystotomy, in two stages, belongs to König, who operated in 1882. The year 1882 was the most memorable of all in the development of gall-bladder surgery, for it was in this year that Langenbuch first performed the operation of cholecystectomy. To Langenbuch, as much as to any surgeon, belongs the credit of establishing the surgery of the gall-bladder upon a firm footing. His operative work is the work of a pioneer, and his book upon the diseases of the liver and the gall-bladder is probably the soundest and most authoritative treatise we possess. Langenbuch, on July 15, 1882, after long practice of the operation upon the cadaver, performed cholecystectomy upon one of his patients, and a speedy and successful result followed. Other similar operations were performed by Langenbuch himself, by Courvoisier, and by Riedel.

The year 1882 saw the first performance of another operation upon the bile passages, the operation of cholecystenterostomy, which was carried out in six stages by von Winiwarter. The suggestion of the operation is due to Nussbaum. Von Winiwarter united the gall-bladder to the colon. Cozi, after many experiments upon dogs, suggested that the anastomosis should be made with the duodenum. This was done by Bardenheuer and Terrier. In 1885 Roth, a Swiss surgeon, suggested that, in blockage of the common duct the cystic duct might be implanted in the duodenum.

The year 1884 saw the first attempts in surgical inter-

ference with the common duct. The operations of choledochotomy and of duodeno-choledochotomy were both suggested by Langenbuch, and the possibility of their performance demonstrated by experiments upon the cadaver. Duodeno-choledochotomy was first performed by MacBurney, then by Pozzi and Kocher. Choledochoduodenostomy was first performed by Riedel unsuccessfully, by Sprengel successfully.

The first surgeon to attempt choledochotomy was Kümmel; the result was unsuccessful. Courvoisier performed the first successful operation. In 1891 Hochenegg, after removing a stone from the common bile-duct, did not introduce sutures, but drained the wound with gauze; his patient recovered. The operation of choledocholithotripsy was performed by Langenbuch, Courvoisier, Lawson Tait, and others. Rehn was the first surgeon to perform cholecystectomy and choledochotomy successfully.

In the year 1884 Küster performed the first operation for acute ulcerative perforation of the gall-bladder. The first hepatotomy was performed by Körte.

In the year 1883 Sir Spencer Wells recommended the operation of ideal cholecystotomy, or cholecystendysis. Two unsuccessful results were recorded by Meredith, and were followed by a successful operation performed by Courvoisier.

In 1884 Riedel operated successfully for the relief of a fistula of the gall-bladder, communicating with the colon and with the right pleural cavity. Krönlein in 1886 closed a fistulous track which extended from the gall-bladder to the bladder, and one year later von Bergmann evacuated gall-stones from a distended patent urachus which communicated with the gall-bladder.

In 1886 Landerer performed cystolithectomy through the liver substance, and Lauenstein hepatolithectomy in two stages.

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In 1890 Hochenegg was the first to remove a malignant tumour of the gall-bladder, and in the same year Terrier removed a growth which involved the gall-bladder and the adjacent portion of the liver.

The use of omental flaps and grafts for walling off incisions in the bile passages was advocated first by Courvoisier and by Mayo Robson. The first operations for peritoneal adhesions which crippled the action of the gall-bladder and the stomach were performed, according to Langenbuch, by Riedel and Lauenstein. In England, Mayo Robson, and in France, Terrier, both recognised the harm done by adhesions affecting these organs, and the great relief afforded by the free division of them. The operation of cysticotomy originated with Küster.

In England, the first surgeon to operate deliberately and with success for gall-stone diseases was Lawson Tait. No small measure of credit for the successful performance and advocacy of the surgical treatment of diseases affecting the gall-bladder and bile-ducts is due to two surgeons attached to the Leeds Infirmary, McGill and Mayo Robson. McGill was undoubtedly one of the pioneers in this branch of our art, and, possessed as he was of the very genius of surgery, he would, if his brilliant career had not been prematurely cut short, have achieved in it a great and enduring reputation. What Mayo Robson has done for the surgery of the abdomen in general, and perhaps especially for the surgery of the gall-bladder, is well known to all. His little work, published in 1892, followed by his Hunterian lectures, and three editions of the work based upon them, are a record which we, at his hospital, are proud to remember.

GENERAL OBSERVATIONS.

In all operations upon the gall-bladder or upon the bile-ducts a considerable advantage will be derived from the use of a sand-bag placed under the patient's back at, or a little above, the level of the liver. The liver by this means is made to present in the wound and easy access



FIG. 58.—Shewing the position of the sand-bag in operations upon the gall-bladder and bile-ducts.

is obtained to the cystic and common ducts. The intestines fall away into the pelvis, and the whole operation area is made more accessible. In addition to this use of the sand-bag it will be found a convenience to be able slightly to tilt the table so that the head of the patient is raised and his feet lowered about four to six inches.

It is to Wheelock Elliot of Boston that we are indebted for the first demonstration of the great advantage to be

derived from the placing of the patient in this position. He writes (*Annals of Surgery*, 1895, vol. 22, p. 97):

“The patient is hung by straps under the arms on an inclined plane at an angle of something less than forty-five degrees. A sand-bag is placed under the back, so that the patient is bent over it. In this position the intestines gravitate to the lower part of the abdomen, so that when the liver is held up by a retractor, the air sucks in between the liver and intestines much as it enters the pelvis in the Trendelenburg position.

The only disadvantage of this position is that, when a vertical incision is employed, the edges of the wound are necessarily very tense, owing to the pushing forward of the rib margin and the consequent tightening of the abdominal muscles. This solitary disadvantage is done away with when Mayo Robson's incision, to be presently described, is used. This position of the patient is, as a fact, indispensable for easy work upon the ducts.

The best incision is a vertical one, made at first about four to five inches in length through the right rectus near its outer border. The upper end of the incision starts at the costal margin and extends vertically downwards. If more room is needed than this incision gives, it may be obtained by prolonging the incision downwards, or by carrying the upper end obliquely upwards and inwards, dividing the fibres of the rectus about one-half of an inch from the costal margin. There is rarely any need for a further increase of the incision than these. The incision near the outer margin of the rectus, with the upward and inward extension, is that first suggested by Mayo Robson.

Great convenience may often be gained, especially in stout patients with an abdominal wall three inches or more in thickness, by making the skin incision two or three inches longer than the incision in the rectus. The sides of the wound then fall away and allow the more ready access of the hand. The longer incision in the skin and subcutaneous fat does not in any way weaken the abdominal wall, as a longer incision in the muscles would certainly do.

Dr. Arthur Dean Bevan of Chicago has suggested (*Annals of Surgery*, vol. 30, p. 17) the use of an **S**-shaped incision, the lower end of the vertical incision being carried outwards, and the upper end obliquely upwards and inwards. Dr. Bevan claims that by means of his incision less damage is done to the vessels



FIG. 59.—Mayo Robson's incision.

and nerves of the abdominal wall than by other incisions, and that a better view can be obtained of the bile-ducts. The incision of Mayo Robson is practically the same as the upper part of Bevan's incision.

Kocher uses an oblique incision four inches in length, about one and one-half inches below the costal margin. The centre of the incision is a little outside the outer margin of the rectus muscle. This is a very useful incision, giving ready access to the gall-bladder and ducts, being readily enlarged either inwards or outwards, and

doing little damage to the nerves or muscles of the abdominal wall. Very little weakness of the parietes remains after the operation, and there is little chance of a hernia developing. This incision and the vertical incision, with Mayo Robson's extension, are the only ones I have adopted. So far as I am aware, I have not had a single case of post-operative hernia. This I attribute in part to the method of making the incision (a large skin wound and a small muscle wound), but chiefly to care in

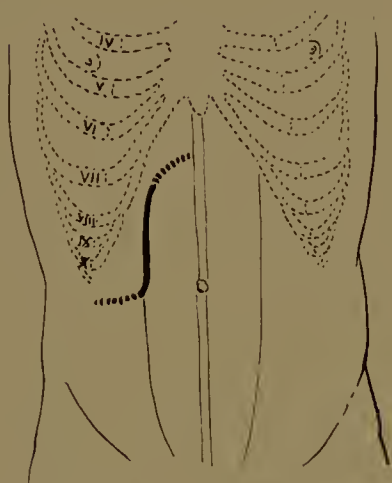


FIG. 60.—Arthur Dean Bevan's incision.



FIG. 61.—Kocher's incision.

stitching up the wound. Courvoisier's incision is eight to ten inches in length, and runs almost parallel with the costal margin. Kehrer makes use of an incision even longer than this.

Such phenomenal incisions as these two latter are never necessary. With a vertical incision five or six inches in length, and at the most an oblique upward and inward prolongation of this just below the costal margin, any operation can be performed upon any part of the gall-

bladder or the cystic or common or hepatic ducts. Provided the ducts are brought within easy reach, then the smaller the incision the better, for the intestine can the more readily be packed away with swabs or sponges. A long incision is troublesome in that it allows the escape of intestines from the wound and makes the retention of the bowels within the abdomen a matter of constant attention. As soon as the abdomen is opened and a preliminary exploration has been made, a large flat swab is packed down towards the upper part of the right kidney

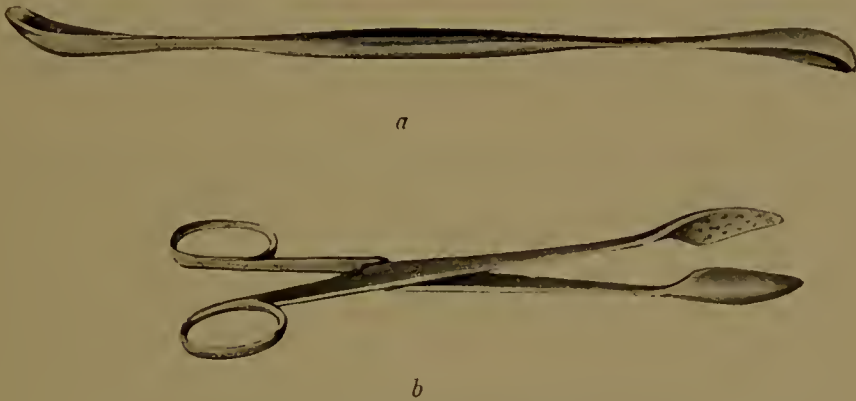


FIG. 62.—Gall-stone scoop (*a*) and forceps (*b*).

pouch. The proper placing of this swab is a matter of the greatest importance. It should fill the upper part of the right kidney pouch, fitting in between the common duct and the duodenum on the inner side, and the abdominal wall on the outer side. When fixed in its correct position, it forms an adequate protection against any leakage from the opened bladder or ducts. When the operation is completed and the swab is removed, there should have been no soiling of any part of the peritoneum which it covers.

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A second swab of smaller size is then passed towards the middle line, to lie above the stomach to the inner side of the common duct. The exact fixing of this is also important, though it is more easily placed than is the former. A large swab is also placed so as to cover the intestines and protect them entirely. If, in very stout patients, one swab will not suffice for this, two or more may be introduced.

The liver and the gall-bladder are then freed from any adhesions. These are sometimes thin, loose, and easily divided; at other times they are exceedingly tough, intricate, and difficult to separate. The greatest care and deliberation must be exercised in disentangling these. Any hurry or any undue force may be fatal; the colon or the duodenum, or even the stomach, may be torn, and leakage from these viscera may contaminate the whole field. A rough separation of the omentum may cause a profuse hæmorrhage, and the torn vessel, retracting, may cause a large hæmatoma to form in the substance of the omentum. In the stripping of all these adhesions great help will be found in the use of gauze, which wrapped around the fingers slowly peels the adhesion away. It is most essential that all the ducts and the gall-bladder should be freed and laid bare before the operation proceeds further.

Unless all the bile-tract can be explored, there is a great risk of a small calculus, or even of many calculi, being left behind. Adhesions, even the very firmest, will yield to time and patience and dexterity. No operation need ever be abandoned because the adhesions are supposed to present an insuperable obstacle. I have, on

many occasions, seen adhesions that at first were utterly bewildering in their infinite complexity, but gentle persistence in separating first one spot and then another has gradually cleared all difficulties away.



FIG 63.—Liver rotated through Mayo Robson's incision. When the gall-bladder is pulled upwards in this way, the ducts are straightened and put upon the stretch. Access to them is then quite easy.

When all is quite clear, then the gall-bladder with the liver around it is seized in the hand covered with gauze, and gently dragged downwards from under the shelter of the ribs. If this can be effected, it will be found easy to rotate the liver, turning the gall-bladder upwards, so that

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what was its under surface now faces upward and forwards. By this manœuvre the cystic and common ducts are brought almost into a straight line, and the common duct, which at first seemed so deeply hidden in the abdomen, can now be brought forwards till it lies almost or actually on a level with the skin. In this way the ducts can be most thoroughly explored and the surgeon may satisfy himself of the certainty of being able to remove all the stones.

It is not necessary in all cases to bring the liver and gall-bladder forward in this way, but in case of any doubt, it is certainly advisable to do so. In thin patients this may be done through the usual vertical incision, but in the stouter patients the upward and inward prolongation of the incision will first be necessary.

In stout people it is sometimes difficult to make the liver rotate, and thus to bring the ducts forward, but even if the manœuvre cannot be completely effected, it can often be done to such an extent as to make the steps of the operation much easier. If the patient be thin, and if, as in spare women, the liver lies with its edge well below the costal margin, it is perfectly easy to bring the common duct well up to, or even outside, the abdominal wound, and there to incise or suture it.

During the operation it is advisable in all cases, but more especially in those patients suffering from chronic jaundice, to ligature every bleeding point.

After the intra-abdominal portion of the operation is completed it is necessary to remove the sand-bag from beneath the patient's back before stitching the wound. The peritoneal stitch is excessively difficult to introduce

while the epigastrium is made tense and prominent by the sand-bag.

The preliminary treatment of patients who are to be operated upon for gall-stone disease is the same as in all abdominal operations. In cases of chronic jaundice Mayo Robson, acting upon the experimental observations of Wright, has administered chloride of calcium, either by the mouth or by the rectum, in the hope that the coagulability of the blood might thereby be increased. I have never been convinced that this drug had any effect whatever in this direction, and though I formerly gave it a fair trial, I have now ceased to administer it.

In some few cases I have given gelatine subcutaneously with the same hope—but this also I have abandoned as being useless.

The abdominal wound is closed in the following manner:

The parietal peritoneum is seized on each side with two or three pairs of clips which hold the cut edge of the peritoneum and also the posterior sheath of the rectus muscle. The clips are given to an assistant, who holds them away from the abdominal wound with sufficient force to facilitate the ready introduction of the stitch. Too forcible a drag must not be made, or the clip will be pulled away. A continuous catgut suture is now introduced, beginning at the lower end of the wound. It takes up on each side the posterior sheath and the peritoneum together. If the rectus is very thick, a portion of this may also be included. This is much better than the practice usually followed of seizing only the peritoneum, for if there be any tension on the stitches, the needle may cut

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through, or the stitch, after being tightened, may break away. This stitch is continued from the lower end of the incision to the top if the wound is to be closed completely. If a drainage-tube is left in the wound, the stitch is continued up to the tube. The same stitch having reached the upper end of the wound, or the tube, is now introduced from above downwards, seizing the rectus muscle and the anterior sheath; when the lower end of the wound is reached, the end of the suture is tied to that end which was left long when the stitch was begun. The stitch is carefully introduced and accurate apposition ensured. In thin patients this suture is quite enough to ensure a firm cicatrix, but in stout patients, or in any patients whom, because of old age or feebleness or old-standing chest disease, I may wish to get out of bed within three or four days of the operation, I first introduce a series of deep silkworm-gut sutures. These are introduced about one-half of an inch from the margin of the wound; they pass through all the structures of the abdominal wall except the peritoneum, being brought out on the one side and re-introduced on the other between the posterior rectus sheath and the peritoneum. These sutures are placed about three-fourths of an inch apart. They are not tightened until the catgut suture has been passed, as already described. When this catgut suture is completed and its ends cut short, the silkworm-gut sutures are knotted. It is not necessary—it is, in fact, harmful—to draw them very tight. As long as they draw the opposing walls comfortably together, that is all that is needed. Tension is to be avoided. A continuous stitch of thin Pagenstecher thread is now introduced close

to the wound edges to ensure accurate skin apposition. However carefully interrupted sutures are passed there is a risk of having overlapping of the skin edge, and, therefore, delay in the sound and perfect healing of the wound. For this suture a triangular pointed straight needle is used.

THE OPERATIVE TREATMENT OF STONES IN THE GALL-BLADDER.

When stones are present in the gall-bladder, they may be removed by cholecystotomy or by cholecystectomy. The operations will be separately considered.

CHOLECYSTOTOMY.

Indications for the Performance of the Operation of Cholecystotomy.—Cholecystotomy is the operation most commonly practised at the present day for stones which are found in the gall-bladder. Under certain circumstances it has been replaced by the operation of cholecystectomy. As to the conditions which demand the latter operation, and as to those in which it will probably be the operation of choice, I propose to speak later. There are, however, certain cases for which cholecystotomy will always remain the only satisfactory operative procedure. Though the experience of many surgeons seems to be urging them to perform cholecystectomy far more frequently than before, there will always be some cases for which cholecystotomy must be performed. The need for this particular operation will be determined in part by the conditions found when

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the abdomen is opened and the bile passages explored, but more often by the general condition of the patient. In not a few gall-stone operations, especially in older people suffering from a severe infection, that operation is the most desirable which gives the speediest relief. It is not a permanent cure of the disease that at such a moment is the surgeon's chief desire, but rather some quick and assured means of giving relief to urgent and threatening symptoms, so that the patient may be brought safely through a time of great peril. When the danger is past, then a further step towards the permanent cure of the condition may, if necessary, be safely taken. Broadly speaking, therefore, cholecystotomy will be demanded where there are the acute infective conditions for which instant relief is necessary and in patients whose powers of withstanding the shock of any detailed operative procedures are small. That surgeon will have the best results who does not *always* follow any method, but, taking a just measure of his patient's powers, chooses that measure of relief which seems to him, in each case, to be the best; one in the practice of which he is the most expert. This is more especially the case in gall-stone surgery, for so many conditions, each one a menace to the patient's life or comfort, may be present at the same time. A stone in the ampulla, infectious cholangitis, cholecystitis with ulceration of stones into the liver, for example, were present in two consecutive cases of my own. For the gall-bladder condition alone, cholecystectomy would have been correct. But whether in such circumstances it should be done in the presence of the other conditions will depend upon the

patient's condition, the difficulties or the ease of that particular operation, the surgeon's former experience, and so forth. In these two, I performed transduodenal choledochotomy and cholecystectomy, and after taking away the cystic duct, I left a tube in the common and hepatic ducts. Both patients recovered. To have attempted such an operation in old or weakly patients would have been worse than folly.

One point which requires further investigation is as to the frequency and the character of the after-results of cholecystotomy. It is desirable that we should know of the frequency of recurrence of gall-stones (and this should be distinguished from the spurious recurrence which is the sequel of incomplete removal of stones), and of the symptoms that ensue when adhesions have formed to a chronically inflamed gall-bladder, even after all stones have been removed. Of the former some evidence is forthcoming, though no doubt it is not all available; of the latter there is also evidence, and Fürbringer (*Arch. f. phys. u. diät. Therap.*, July, 1903) has said that "post-operative adhesions to the gall-bladder embitter the lives of many patients."

The majority of surgeons will agree with Dr. Maurice Richardson when he says (*Med. News*, May 2, 1903, p. 817): "The end-results in simple cholecystotomy are certainly as gratifying as end-results have ever been in any class of abdominal operations."

Operation.—The operation of cholecystotomy has been practised in two ways: In one, the gall-bladder, after being opened and cleared of stones, is stitched up and returned within the abdomen; this method

is known, most inappropriately, as "ideal" cholecystotomy, or as cholecystendesis (Courvoisier). In the other method the gall-bladder is opened, emptied, and stitched to the abdominal wall in such a way that drainage through the incision is permitted. The former method, first performed by Meredith in 1883, is rarely, if ever, practised by experienced surgeons now.

Since it has been recognised that many of the symptoms and all of the complications of gall-stone disease are due to an inflammation in the gall-bladder or bile-ducts, it has properly become the custom to drain the bile passages until the time, varying in different cases, when the inflammatory processes have subsided. The great principle which has to be carried out in gall-stone surgery is drainage. Without drainage there is a risk of imperfect healing of wounds made in the bile passages, and, therefore, of leakage subsequently of their contents, of small calculi or sand or inspissated bile, or even pus remaining, and of that condition of the mucosa persisting (stone-forming catarrh) which was responsible in the first instance for the formation of gall-stones. "Ideal cholecystotomy" is anything but ideal in practice, and is an operation that is mentioned now only that it may be unequivocally condemned.

Cholecystotomy is performed in the following manner: When the abdomen has been opened in the manner already described, and the gall-bladder and ducts and the head of the pancreas thoroughly explored and freed from all adhesions, the operative area is packed round with gauze swabs wrung out of hot sterile salt solution. If

the gall-bladder is of moderate or large size, it will be found quite easy to draw the fundus up into the wound. An aspirating needle is now thrust into the fundus of the gall-bladder and all the fluid contents drawn away. While this is done, the fundus should be seized with a Spencer Wells clip on each side of the puncture, to steady the gall-bladder and to hold it forward when it is empty and perhaps collapsed, so that it does not slip away when the needle is withdrawn. The fluid removed from the gall-bladder should be considered septic. The needle, therefore, which has been within the bladder should not be touched, nor should any drop of exudate from the puncture be allowed to soil the hands or any portion of the wound. The swabs used to mop the puncture, or those which in a later stage are soiled with the fluid from the bladder, should at once be thrown away. The puncture in the fundus is now enlarged with a snip of the scissors until an opening about one-half of an inch or even longer is made. The clips which hold the fundus at each side of this incision are now removed and reapplied so that the edge of the incision is seized. By their means the wound can now be held opened, or when they are crossed over, can be securely closed. Through this opening a large gall-stone scoop is introduced, and the stones removed. If there are many stones, it is advisable to remove only a few at a time; if the scoop be overfull, it is difficult to withdraw from the gall-bladder and some of the stones may fall away into the swabs, and will have to be sought. It will often be found that if many stones are present in the gall-bladder, the smaller ones will be near the fundus and one or more larger ones will lie in the

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pelvis, near to but not occluding the opening into the cystic duct. When all the stones that can be felt with the scoop are removed, the clips on the edge of the opening are crossed so as to pull the edges together, and the fundus

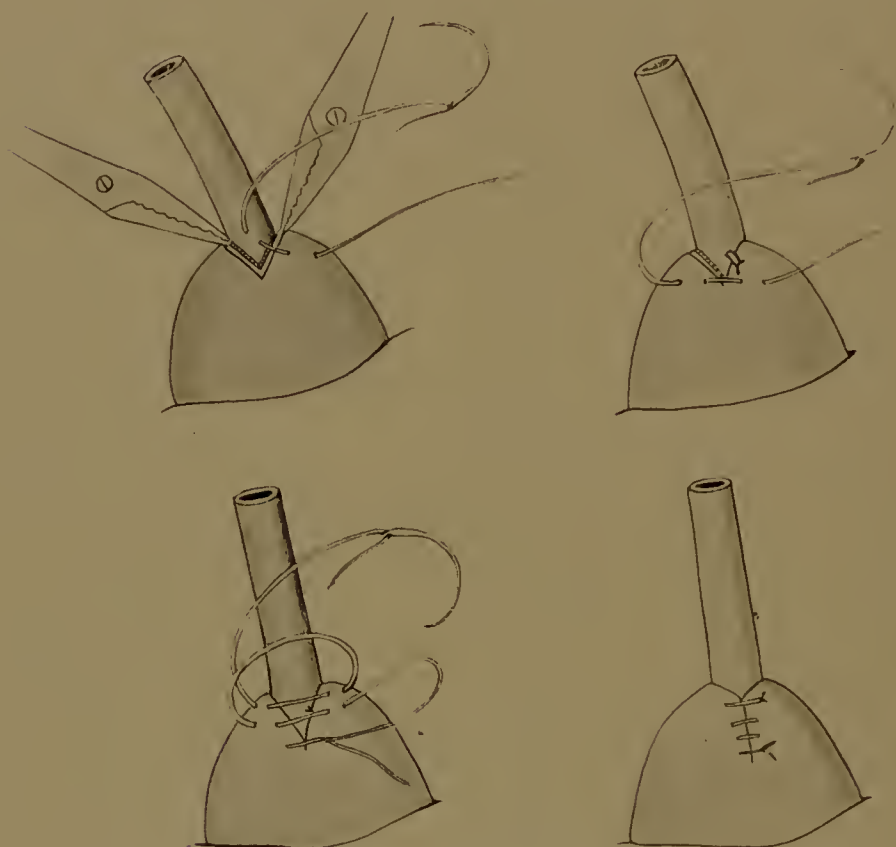


FIG. 64.—Shewing the drainage-tube fixed in the gall-bladder by a single catgut suture and the method of infolding the edges of the wound in the gall-bladder.

of the gall-bladder is wrapped in gauze. The swabs which lie beneath the bladder are then removed or pushed aside, and while the left hand holds the gall-bladder, the fingers of the right hand are slipped along the under surface and the ducts are again explored. If a stone or stones be felt in the cystic or hepatic ducts, an attempt is

made to "milk" them backwards into the gall-bladder. If any difficulty is experienced with a stone in the pelvis or in the cystic duct, the scoop may be re-introduced, and may be worked within the bladder in concert with the fingers outside. In this fashion a stone which is seemingly imprisoned may be dislodged. When all stones are, so far as can be seen, entirely cleared away, a final examination of the duct

is again made, and if they are found to be clear, the swabs may be removed from the kidney pouch and from above the stomach, one swab only being left beneath the centre of the wound. A tube is now

introduced into the gall-

bladder. The size most often used is about one-third of an inch in diameter. About two to three inches are laid within the gall-bladder, so that the end of the tube reaches approximately to the pelvis. The tube is now fixed by a single catgut stitch which passes, on the one hand, through all the coats of the gall-bladder except the mucosa just beyond the edge of the opening, and, on the other, through the tube. This is tied, and the tube thereby is fixed firmly. The incision and this stitch are now buried in one of two ways: either by taking a purse-string suture around the wound and tightening this, as the tube is pushed deeper into the gall-bladder, as is done in Senn's method of gastrostomy,

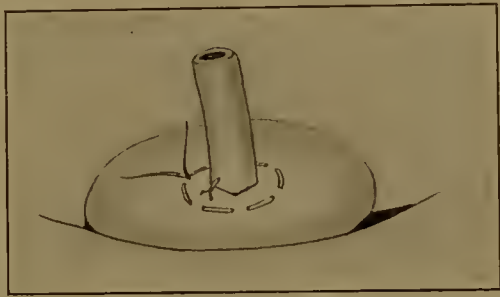


FIG. 65.—Gall-bladder closed around drainage-tube by means of a purse-string suture.

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or a continuous stitch is taken from side to side of the incision, taking all the coats except the mucosa, so that on drawing this tight the edges are infolded, as in Kader's method of gastrostomy. The stitches in either case are made to embrace the tube closely so that no leakage

can occur by its side.

The swab within the abdomen is now removed, and the abdominal wound closed in the usual manner. The gall-bladder may be allowed to fall back within the abdomen, or, preferably, it may be fixed to the parietal peritoneum in the following way: The continuous suture of catgut which is first introduced to suture the peritoneum and the posterior sheath of the rectus is begun at the lower end of the wound. When it



FIG. 66 — Drainage-tubes: *a*, Split rubber tube with gauze wick; *b*, the rolled tube of gauze and dental rubber.

reaches the middle or a little above the middle, the needle is passed through the wall of the gall-bladder, avoiding the mucosa, as it crosses from the left to the right edge of the wound. The stitch then returns to the lower end of the wound, taking the anterior sheath of the

rectus. The upper part of the wound, that which lies above the tube, is similarly treated, the stitch now beginning at the top of the wound and working downwards to the middle until the gall-bladder is reached, when, as before, a single suture is passed through it. The gall-bladder is then held by two stitches, one above, one below. There is no need to fix the gall-bladder by interrupted sutures closely placed together, or even by a continuous suture. The two stitches passed in the way described suspend the gall-bladder quite satisfactorily.

THE OPERATIVE TREATMENT OF STONE IN THE CYSTIC DUCT.

When a stone is present in the cystic duct, it may be loosely fixed, being contained in a pouch or diverticulum, and interfering very little with the passage of bile and mucus, or it may be tightly wedged in the duct and in this way may cause a condition of hydrops or of empyema, or, in the latest stage, of cysto-intestinal fistula. A stone wedged in the pelvis of the gall-bladder is not to be distinguished from a stone in the cystic duct, for, when it has been long stationary, the gall-bladder may narrow behind it, forming an "hour-glass gall-bladder," the pouch in which the stone is lying then resembling a dilated cystic duct.

When the stone is found in the cystic duct, it may be dealt with by crushing, *cholelithotrixy*, by incision of the duct, *cysticotomy*, followed by suture of the duct or drainage, or by *cholecystectomy*, the gall-bladder and

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cystic duct being removed in mass or by *cholecystotomy*.

Of the operation of *cholelithotrixy*, whether for stone in the cystic or for stone in the common duct, I have not had, and I do not anticipate that I shall have, any experience. The method seems to me to be one that was only fitted for, perhaps compulsory in, the earliest days of the operative treatment of gall-stones. But at the present time it is rarely if ever necessary, and should only be reserved for those cases where any other method of removal seems impossible or extremely hazardous. The disadvantages of the method are that it is likely to damage the duct, and therefore, perhaps, to lead to rupture, ulceration, or stenosis, that it is uncertain,—other stones being overlooked and left untreated,—and that some fragments of the crushed stone may remain behind to form the nucleus of other stones. It is, in fact, a crude and imperfect method. The needling of a stone or stones through the duct wall finds no place in the surgery of to-day.

Cysticotomy.—The removal of stones from the cystic duct through an incision which is subsequently sutured, or into which a drainage-tube is introduced is an operation that is occasionally, though rarely, necessary. The operation was first performed by Lindner in 1891 upon a patient from whom he also removed the gall-bladder. Kehr in 1892 removed a stone from the duct and closed the opening by suture, draining the gall-bladder.

The neck of the gall-bladder and the cystic duct are exposed by the method of rotation of the liver already described. When the duct is exposed, it is incised, the

stone or stones removed, and a further exploration of the duct made at once. If the bile passages are found to be clear, the wound may be closed by a continuous catgut suture which misses the mucosa. This will close the incision satisfactorily, but a second supporting layer of sutures, either of catgut or preferably of thin celluloid thread, should also be introduced. A drain is then placed in the gall-bladder and the abdominal wound is closed in the usual way.

When the stone is tightly wedged in the duct and hydrops or empyema has resulted, the operation to be practised will depend very much upon the general condition of the patient and upon the especial conditions found when the field of operation is exposed. As a rule, *cholecystectomy* should be performed. It is the operation I perform as the routine procedure, in the absence of special circumstances which would add an undue risk to its performance. I have removed the gall-bladder and the cystic duct upon several occasions for these conditions, and the results have been remarkably good. In seven cases of empyema I have lost one patient, on the eleventh day, from suppression of urine, and of five cases of hydrops I have not lost one, and in one case of gangrene of the gall-bladder the patient recovered.

If, however, the condition of the patient is poor and her power of bearing any operation is but small, or if the gall-bladder be adherent, or the mechanical difficulties of the operation, owing to thickness of the abdominal walls, be considerable, *cholecystotomy* should be performed.

It will be found helpful, then, to aspirate the contents

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of the distended gall-bladder very slowly. If the fluid is quickly withdrawn, it will be found that the gall-bladder contracts rapidly on to the stone and forms a tight constriction on the distal side of it. If, however, the fluid be withdrawn slowly and the operator keeps his fingers on the stone, he may be able to squeeze the stone backwards into the gall-bladder, which is still moderately distended with fluid. The gall-bladder should never be emptied until a very thorough attempt at displacing the stone has been made. This little manœuvre is one the use of which I have experienced. The reason for its success is easy to understand. The fact that the stone has been displaced, and that, therefore, the cystic duct is clear, will be appreciated when bile is seen to flow from the gall-bladder. After dislodging the stone, the gall-bladder may be drained as in the ordinary method of cholecystotomy, or the gall-bladder may be removed.

If it is found impossible, after persistent efforts, to dislodge the stone, the operation of cysticotomy is performed, or the gall-bladder is drained and the abdominal wound is closed. The tube used for draining the gall-bladder should be of large size—half an inch or even more in diameter. After the lapse of a few days the stone may be dislodged spontaneously. If it is not, then the tube may be removed, and the gall-bladder be syringed with hot sterile salt solution, or with olive oil, or soap solutions. In one or other of these ways the stone may be displaced, or it is supposed, in part, dissolved. Even after seventeen days, as in one of my earliest cases, the stone may move into the gall-bladder and escape from the wound.

A biliary fistula is then left, which closes spontaneously in the usual manner.

If the stone remains unmoved, then a mucous fistula persists. These fistulæ were much more commonly seen in the early days of gall-stone surgery than they are now. When they exist, it is for the patients to decide whether the discomfort thereby caused is great enough to compel them to undergo a further operation for their relief. As a rule, they cause but trivial inconvenience. Their treatment by operation consists in destroying the mucous membrane of the gall-bladder either by the scraper or by the cautery, or by the knife or, and this in preference, by making a further attempt at the removal of the impacted stone, and, failing that, by performing the operation of cholecystectomy and removing the cystic duct entirely.

Treatment of Biliary Fistulæ.—If, in operating upon a patient for gall-stone disease, a fistula be found between any part of the intestinal canal, on the one hand, and the gall-bladder and cystic duct, on the other, the adherent and communicating viscera should be separated. This must be done with great gentleness so that no unnecessary damage is done to the stomach or intestine. When a complete separation has been made, the opening into the intestine must be trimmed and its closure securely effected by suture. As a rule, a continuous suture of catgut, embracing all the coats of the gut, and outside this a continuous suture of fine Pagenstecher thread, will prove the most satisfactory method of closure. The opening in the gall-bladder or in the cystic duct may be closed by suture, it may be drained, or preferably, the

gall-bladder and the cystic duct together may be removed, as in the cases under my own care to which reference has already been made.

CHOLECYSTECTOMY.

Indications for the Performance of Cholecystectomy.—

In 1902 I read a paper entitled "A Series of Cases of Cholecystectomy," before the Yorkshire Branch of the British Medical Association. I gave then the following indications for the performance of this operation:

1. In injuries of the gall-bladder, rupture, stab or bullet wounds.
2. In gangrene of the gall-bladder.
3. In phlegmonous cholecystitis.
4. In membranous cholecystitis.
5. In chronic cholecystitis with dense thickening of the walls of the gall-bladder and cystic duct, with or without stenosis of the cystic duct, and in chronic cholecystitis, when the gall-bladder is shrivelled and puckered and universally adherent. In such cases it is no longer a receptacle for the bile.
6. In distension of the gall-bladder, hydrops of empyema, due to blockage of the cystic duct by calculus, stricture, growth or external inflammatory deposits; or in cases of mucous fistula following operations for these conditions.
7. In cases of fistula between the gall-bladder or the cystic duct, on the one hand, and the stomach, duodenum, or colon, on the other.
8. In multiple ulcerations of the gall-bladder or the cystic duct when gall-stones have eroded their

way through the walls into the liver, the duodenum, or other protective adherent masses.

9. In primary carcinoma of the gall-bladder.

The result of my early cases was so satisfactory that I was led to put the operation to a more extended proof, and as my experience increases I am tempted to ask whether it would not be the better treatment in many gall-stone operations to remove the gall-bladder entirely.

The experience of every surgeon who has worked extensively in this field of surgery is that the chief purpose and the main indication in any operation for gall-stones is the drainage of the gall-bladder and bile-ducts. Of the validity of this experience there can be no question. We know that gall-stones are rendered troublesome by the cholecystitis or the cholangitis which they are the means of arousing. In many cases it is because of the inflammatory consequences that an operation is demanded. The essential part of any operation would, therefore, seem to be the drainage of the gall-bladder, prolonged for such a time as to allow a complete subsidence of the inflammatory process. But in the very great majority of cases the secondary inflammation has its origin, and runs its course entirely within the gall-bladder; an infection of the hepatic or common ducts does not occur. In many cases, therefore, in removing the gall-bladder, we are doing away with the necessity for drainage by removing that structure, the drainage of which seemed imperative. It is within the gall-bladder that the great majority of stones are formed; it is within the gall-bladder that the secondary inflammatory troubles

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break out, and, in the majority of cases, are altogether limited. The removal of the gall-bladder, therefore, does away with the need for drainage. It renders less likely the formation of gall-stones, and it renders less likely the inflammatory consequences of their presence. If, however, the need for drainage is absolute, it is possible, in fact quite easy, to drain the ducts after the gall-bladder has been removed. After the division of the cystic duct the stump of the duct may be slit up until the hepatic duct is reached, or the cystic duct may be cut off flush with the common duct. It is then quite a simple matter to explore upwards and downwards with a gall-stone scoop or with the finger to make certain that the ducts are clear of calculi, and then to stitch in, by a single catgut suture, a rubber drainage-tube. The presence of stones in the common duct does not debar one from removing the gall-bladder. In two cases I have removed stones from the ampulla of Vater by duodeno-cholechochotomy and have then at once removed a chronically inflamed gall-bladder full of stones which were ulcerating into the liver, and after dividing the cystic duct to the common duct, have stitched in a rubber drainage-tube. Both patients recovered without the slightest interruption. The plea, therefore, that the need for drainage is opposed to the routine removal of the gall-bladder is answered by the facts that when the gall-bladder is removed, the need for drainage does not often exist, as that need was due to the presence of the gall-bladder and that if desirable or necessary, it can be carried out without the smallest difficulty.

An examination into the recorded cases of carcinoma of

the gall-bladder and of the adjacent portions of the liver shews that in approximately 95 per cent., the malignant change is due to the chronic irritation of gall-stones. If the gall-bladder is removed, there will, of course, be no chance of this malignant growth occurring. This is not, however, a point of much importance, for the cases of carcinoma are, as a rule, those in which no operation has been done; by the time the surgeon sees the cases the growth is already there. To make the argument for cholecystectomy a strong one from this point of view, it would be necessary to shew that malignant disease occurred after cholecystotomy, and, so far as I know, this had not been done at the time my paper, already referred to, was written. Since then, however, my colleague, Mr. Lawford Knaggs, has recorded an exemplary instance of this. The case is given at length in the chapter dealing with the "General Pathology of Gall-stone Disease." A similar instance is recorded by Mr. Mayo Robson. The patient was a lady aged fifty-seven, upon whom cholecystectomy was performed in February, 1902. A good recovery followed, and the patient remained well up to August, 1903, except for pain in the gall-bladder. On examination, a tender lump could be felt in the gall-bladder region. On opening the abdomen a second time in October, 1903, the gall-bladder was found the size of a small hen's egg, full of solid material. On incising it the swelling was found to be new growth which was infiltrating contiguous parts of the liver. The gall-bladder and adjoining part of the liver were removed successfully. Cases such as these strengthen materially the plea for cholecystectomy.

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In the very great majority of operations for gall-stones there is ample evidence of long-standing inflammation in and about the gall-bladder. The normal smoothness of the gall-bladder is gone, its deep blue colour is lost, its once supple walls have become thickened and tough. A glance at a gall-bladder during other abdominal operations will tell one in a moment whether stones are lying there. If the gall-bladder is blue, it is healthy; if opaque and grey or yellow, there are, or there certainly have been, stones and a chronic inflammation aroused by them.

In some cases, therefore, it will be conceded that cholecystectomy is the more desirable operation, but before its routine adoption is advocated it is necessary to shew that the gall-bladder is useless, and that its removal does not add any risk as compared with cholecystotomy. In the abstract, one might be inclined to think that the loss of a bile reservoir capable of emptying on demand would be a serious matter to the individual, or at the least, a disability. The perfection of the mechanism of digestion so graphically told by Pawlow would seem to require that bile should be ejected in spurts, as it were, into the duodenum during digestion. But there is clinical experience in abundance to shew that when all the bile is discharged from the body through an external biliary fistula, without a drop entering the intestine, the individual suffers no sign of disability of any kind. There is abundant evidence also, furnished by my own cases and by many others, to shew that the removal of the gall-bladder does not interfere with digestion, that the individual eats well, gains in weight, and to all appearance

has the same duodenal digestion as an ordinary healthy individual. The gall-bladder, therefore, if not useless, can quite well be spared.

The removal of the gall-bladder in cases judiciously selected does certainly not involve a greater risk than the operation of cholecystotomy. I have, in fact, in several cases been convinced that the removal of the gall-bladder made the operation simpler and shorter than it would have been if a multitude of small stones had been removed. By carrying out the operation in the manner described below it will be found a safe, speedy, and simple procedure. During the last three years I have inclined more and more to the performance of cholecystectomy, and after some hesitation and some trepidation, which experience has removed, I am strongly disposed to advocate the frequent, though certainly not the invariable, adoption of this operation in preference to cholecystotomy. Its advantages are that the operation removes the chief source of the disease, that it thereby prevents in great measure a recurrence either of stones or of the inflammation which betokens their presence, that growths in the gall-bladder or adhesions around it are subsequently impossible, and finally that the wound, if drainage is not required, may be caused to heal throughout by first intention. The gall-bladder is devoid of any strikingly useful purpose, and its removal does not add appreciably to the danger of the operation. If drainage of the ducts is necessary, it can be carried out quite satisfactorily. The presence of a stone in the common duct does not prohibit the operation, but drainage of the duct, after removal of the stone in the duct or in the ampulla, is necessary.

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The one disadvantage that may justly be urged against cholecystectomy is this: that if a late operation should become necessary—for stones can, and do, form in the hepatic and common ducts—such an operation would be more difficult and almost certainly more dangerous. The possibility of a further operation being necessary cannot be denied, but the likelihood of it is negligible.

Dr. W. J. Mayo, of Rochester, Minnesota (*Annals of Surgery*, vol. 38, p. 454), gives the following account of his opinion with regard to drainage in gall-stone operations:

(1) If the gall-bladder contained bile, and the organ was distensible, if the gall-bladder was removed, bile drainage was provided for by cutting the cystic duct across and leaving it open. If such a patient was very obese or had degenerative lesions of other organs, he preferred cholecystotomy. (2) If there were symptoms of cholangitis, even of mild grade, he provided for bile drainage, and if the condition was acute, the drainage must be free. (3) If the gall-bladder contained cystic fluid, but no bile, and the patient had symptoms of cholangitis, he removed the organ and cut the cystic duct below the obstruction to permit of bile discharge. If necessary, the cystic duct was split down to the common duct. (4) In a few cases he had directly opened the common duct for the purpose of securing liver drainage; but it was very rare that this was necessary, unless there were or had been stones in the common duct, and it was dilated. The cystic duct ordinarily could be advantageously used for the purpose; although in a few instances he had found it necessary to cut it off flush with the common duct, leaving a lateral defect in its wall for drainage purposes. This brought up the question as to how much

danger of peritonitis there was as a result of bile leakage into the peritoneal cavity. If there was free gauze drainage, with or without tubage, there was but little danger of peritoneal infection from the bile. He had never seen a case of death from this cause; but the drainage should be attached to the proper point by a catgut suture to prevent its floating away by the bile discharge or displacement by the action of the diaphragm upon the liver. If the common duct was greatly dilated, and after removal of the calculi there was considerable detritus, the end of a rubber drainage-tube was inserted into the duct opening and secured by a catgut suture. If this condition did not exist, tubage of the common duct was unnecessary.

To sum up: Cholecystectomy was to be preferred if the patient was otherwise in good condition. If the cystic duct was obstructed and the gall-bladder contained only cystic fluid, ligation of the cystic duct, without provision for hepatic drainage, was safe. If there was any infection of the hepatic ducts, bile drainage was essential.

Dr. Maurice Richardson (Med. News, May 2, 1903) gives the following indications for extirpation of the gall-bladder:

“(1) Certain lesions in themselves demand removal of the gall-bladder whenever possible. Such are new-growths and gangrenes. (2) Certain other lesions of the gall-bladder are better treated by cholecystectomy. These are the contracted and inflamed gall-bladders, with thickened walls. All gall-bladders which do not permit easy and efficient drainage should be extirpated, for in such gall-bladders the risks of drainage are quite as great as the risks of extirpation; and the one great

advantage of retention is impossible—retention of the biliary reservoir to fulfil the functions of that reservoir, and to permit, if necessary, renewed drainage in future years. (3) Drainage is preferable in the dilated and infected gall-bladder, which, however, is neither gangrenous nor to any great extent changed—the slightly thickened gall-bladder containing gall-stones and infected bile. This gall-bladder will, after drainage, become normal, and, therefore, capable of fulfilling the functions of a gall-bladder. Through it the biliary passages will become effectually drained, after subsidence of the temporary swelling about the cystic duct. (4) As a rule, drainage rather than extirpation is demanded in acute cholecystitis with severe constitutional symptoms, when the gall-bladder is dilated, or at least not contracted, and when it is not gangrenous. (5) In chronic cholecystitis, with dilatation and thickening of the gall-bladder, especially when a stone is impacted in the cystic duct, extirpation is the preferable operation, unless the stone can be dislodged backwards into the gall-bladder, in which case drainage is, if not preferable, quite as advantageous as extirpation. (6) In simple gall-stones, without visible evidence of infection or chronic changes incompatible with restoration of function, simple drainage of the gall-bladder is indicated. (7) In chronic pancreatitis, whether associated with gall-stones or not, drainage through the gall-bladder is indicated. Cholecystectomy is unjustifiable, for immediate drainage is essential. Furthermore, reopening of the biliary passages may, in the future, be required.”

The Operation.—Cholecystectomy was first performed by Langenbuch on July 15, 1882.

The operation is performed in the following manner: Mayo Robson's incision is made, the abdomen opened, the

adhesions separated, and the liver rotated in the manner already described. The gall-bladder may be removed from before backwards, or from behind forwards; that is to say, the cystic artery and duct may be first cut across and the gall-bladder stripped up towards the fundus, or the peritoneum around the fundus may be first divided and the gall-bladder stripped up towards the cystic duct. I have adopted both methods, but prefer the former, as the only difficult part of the operation, the ligature of the pedicle, is accomplished first.

The liver being held upwards, the cystic duct and its termination in the common duct are defined. A circular peritoneal incision is now made around the cystic duct about half an inch from its termination, and a peritoneal cuff is stripped up towards the common duct. In this way the cystic duct is cleared to the view. Two clips with a curved beak are now placed on the cystic duct, and the duct is divided between them. The clip on the gall-bladder side prevents any leakage during the further steps of the operation. The stump of the cystic duct is ligatured with catgut, and the clip on its divided end is removed. The frayed end of the duct is trimmed away with scissors. The cystic artery and vein are now defined. They lie above and to the inner side of the divided duct, and may be readily seen by gently stripping with gauze that part of the pedicle which remains. Two clips are applied and the vessels are divided between them. The proximal end of the vessels is now ligatured with catgut and the clip which secures them is removed. Occasionally, another vessel than the cystic artery may need to be clipped and ligatured; it is a separate branch

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of the hepatic which passes to the common and cystic ducts. If there is no inflammation of the common duct, and if, therefore, there is no need for drainage, the stump of the cystic duct may be covered completely by its peritoneal cuff, which is fixed over it by one or two sutures of fine Pagenstecher thread. A small flat swab is then placed over the common duct, and the separation of the gall-bladder from its fossa is begun. This is most easily and expeditiously effected by working upwards towards the fundus with the index finger, which is insinuated at first between the pelvis of the gall-bladder and the liver. The finger may be covered with gauze so as to make the separation easier. A little patience will soon secure that the gall-bladder is stripped cleanly away, and is left attached only by a peritoneal fold around it. This fold is then divided about one-half to three-fourths of an inch away from the liver, and the gall-bladder then comes away. A raw surface fringed by a collar of loosely hanging peritoneum is now left. From this raw surface there may be some oozing. This is checked by the pressure of a swab wrung out of hot sterile salt solution. Rarely a suture may be necessary if any vessel bleeds. This is passed with a curved intestinal needle and tied gently. When all the oozing has stopped, the peritoneum around the denuded surface is closed over it by a continuous suture of catgut which passes from the liver edge to the cystic duct. A final cleansing of the operative area is needed and the abdomen may then be closed.

If, however, drainage of the common duct is necessary, it may be secured in one of two ways, either immediately

or after the lapse of a few days. If immediate drainage is desired, the cystic duct is not ligatured in the manner described. When that stage in the operation is reached, the clip is removed from the stump of the cystic duct, and the cut edges are seized with fine French vulsella. The duct is slit up and an opening is made into it at its junction with the hepatic duct, of sufficient size to permit of the introduction of a rubber tube. This is fixed in the duct by a suture of catgut which picks up the wall of the common duct a little distance away from the cut edge. To the outer side of this tube a second one, which is split and has a gauze wick, passes backward into the kidney pouch. This second tube may come through the abdominal wound or be made to project from a stab-wound in the loin, preferably the former. If it is thought desirable to postpone the drainage for a few days, the following plan which I have found convenient may be adopted. The clip on the cystic duct is removed and a small clip placed so that the open end of the duct is just seized. Around this a single thin catgut ligature is placed. The peritoneum is not stitched over the stump of the duct. A rubber tube is now passed down to the ligatured duct, and it may be fixed by passing a stitch through it and through the peritoneal cuff. The peritoneum is not sutured over the divided end of the duct. The catgut ligature which closes the duct soon gives way, in three or four days, and bile then begins to flow through the tube. By this time an impermeable rampart of adhesions will have formed around the tube, and will effectually prevent any leakage into the general peritoneal cavity.

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Drainage may or may not be necessary after cholecystectomy. If cholangitis be present, as in those cases where a stone is also removed from the common duct or from the ampulla, it is certainly necessary. If, however, the inflammatory changes are limited to the gall-bladder, drainage need not be provided, the whole abdominal wound being soundly closed.

LUMBAR CHOLECYSTOTOMY OR CHOLECYSTECTOMY.

In a certain small proportion of cases the opening or the removal of the gall-bladder in the loin may be deemed necessary, as, for example, when a mistaken diagnosis of renal tumour has been made and the gall-bladder has been exposed. W. P. Manton (*Amer. Med.*, Oct. 4, 1902) describes a case of extirpation of the gall-bladder through a lumbar incision. The diagnosis in this case was nephroptosis with probable cystic metamorphosis of the kidney. When the kidney was brought out of the lumbar wound the gall-bladder, containing a number of stones, could be easily palpated, and was so thoroughly shut off from the general peritoneal cavity either by adhesions or because of its anomalous situation that the operator was able to remove it, with the cystic duct, without much difficulty. The gall-bladder and the cystic duct contained nineteen stones.

CHOLECYSTOTOMY PERFORMED UPON THE LEFT SIDE.

Carl Beck (*Annals of Surgery*, vol. 29, p. 593) records a case of cholecystotomy in which, owing to transposition

of the viscera, the liver lay in the left side of the abdomen, and the incision had, therefore, to be made through the left rectus muscle.

THE SURGERY OF THE HEPATIC DUCT.

When calculi are arrested in the hepatic duct, they may be removed through incisions made into the gall-bladder, into the common duct, or, rarely, into the hepatic duct itself, or they may be crushed and the fragments pressed onwards into the common duct. In the very great majority of instances stones which are felt in the hepatic ducts can be milked downwards and removed during cholecystotomy or during choledochotomy. In very exceptional instances, however, the performance of *hepaticotomy*, that is, incision of the hepatic duct, may be necessary.

Hepaticotomy.—The operation was first performed by Kocher on Nov. 8, 1889, unintentionally and unknowingly. In the hepatic duct, which was closely adherent to the gall-bladder, a stone was tightly wedged. The duct was opened and the stone was removed. Shortly afterwards the abdomen was re-opened, as symptoms of peritonitis were present. Bile was found in the general peritoneal cavity. The patient died.

Other operations were performed by Cabot (1892), Elliot (1894), Czerny two cases, Kehr, and recently Delagénière and Rogers. Cabot's case was one in which many calculi were removed from the gall-bladder. A large stone was then felt in the hepatic duct deep under the liver. The duct was opened with very great difficulty

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and the stone extracted. The duct and the gall-bladder were drained and the patient recovered.

Elliot (*Annals of Surgery*, vol. 22, p. 86) gives the following account of his case:

“On September 4 I opened the abdomen by an incision in the upper right linea semilunaris. The gall-bladder was found empty and flaccid, the ducts were palpated, and a stone was felt deep under the liver in the hepatic duct. The stone could not be pushed along the duct nor crushed with the fingers. No other stone was felt in the common or cystic duct. After separating numerous adhesions, the stone was seized between the thumb and forefinger of the left hand and pulled up from its deep position. Adhesions and duodenum were pushed aside until the stone appeared between the fingers with only the peritoneum and the wall of the duct covering it. The field of operation was packed with gauze to prevent contamination with bile, the duct was incised, and a stone the size of a robin's egg extracted. The duct was closed at once with catgut sutures, a second row of silk sutures including the peritoneum being placed outside. The duct was held with the fingers, and very little bile escaped. A drainage-tube and gauze were packed down to the sutured duct. A rapid and complete recovery followed. The duct did not leak, and on the second day the gauze drain was removed. On the fourth day the abdominal wound was completely closed by provisional sutures. The jaundice had partially disappeared, and the stools were natural in colour. The patient was well in three weeks. Eight months after operation he was known to be in perfect health.”

In Czerny's case and in one of Kehr's the duct was ruptured during the manipulations attendant upon the removal of stones, and the wound was closed by sutures.

An interesting case of hepaticotomy is related by Leonard Rogers. A full account of it is given in the chapter dealing with stone in the hepatic duct.

The operation of **hepaticostomy**, or the opening of the hepatic duct and the suture of the duct in the abdominal wound, was first performed by Knowsley Thornton in 1888. He removed 412 stones from a dilated hepatic duct which formed a swelling closely resembling the gall-bladder. The duct was stitched to the abdominal wall and drained. The fistula closed in fourteen days.

A remarkable case is recorded by H. V. Chapman. An abdominal tumour about the shape and size of a large kidney was felt in the abdomen; it was connected with the liver. The abdomen was opened over the tumour by an incision 13 cm. in length between the umbilicus and the anterior superior spine. There were numerous adhesions which were readily freed. The tumour was seen to consist of a portion of the liver near its anterior margin; at the lower part the wall was thin and seemed likely to burst. A trocar was plunged in, and 480 c.c. of lightly bile-stained fluid were withdrawn. Then with a round needle the tumour was stitched to the abdominal wall, and a few days later was opened and 127 calculi were removed therefrom. The case is described by Pantaloni as "*transhepatic hepaticostomy*." An example of "*subhepatic hepaticostomy*" is recorded by Nicolaysen of Kristiania. The patient was a little girl, aged eight, in whose abdomen a cyst 17 cm. long and 15 cm. broad was felt. The swelling descended about three fingerbreadths below the umbilicus. A year before there had been jaundice for three months; from this the patient recovered, and

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attended school to within three days of her admission to hospital. At the operation the cyst was fixed to the abdominal wall, and six days later was aspirated. Death occurred on the following day. The cyst was found to be formed by a dilatation of the whole of the hepatic and of a part of the common duct. The hepatic duct had been stitched to the abdominal wound. There was no tumour, and no stone could be found. Nicolaysen considered that the deformity was congenital in origin.

Leonard Rogers (Brit. Med. Journ., vol. 2, 1903, p. 706) records a case in which the hepatic duct was opened under the impression that it was the gall-bladder; it was brought to the surface and drained. The patient died the next day; it was then found that the hepatic duct, and not the gall-bladder, had been opened. The duct was immensely dilated behind an impacted stone.

Access to the duct may be readily obtained, as was first shewn by Elliot, by placing a sand-bag under the patient's back at the level of the liver. The manœuvre of rotation of the liver already described makes it a simple matter to expose the duct to view and to easy handling.

The operation of **hepaticolithotripsy**, or the crushing of a stone in the hepatic duct, is at times the safest and the speediest method of dealing with such an obstruction. It was first suggested by Kocher in 1890 and has been performed by Mayo Robson, Delagénère, and recently by Marcel Baillet (Bull. et Mem. Soc. de Chir., vol. 29, p. 1194). The last case was one in which choledochotomy and suture of the common duct had been performed. The symptoms were not relieved, and nine days later the abdomen was re-opened and a stone, found in the hepatic duct, was crushed. The result was good.

CHAPTER XI.

OPERATIONS FOR OBSTRUCTION OF THE COMMON DUCT.

CHOLEDOCHOTOMY.

A stone may be impacted in the common duct in any point of its course. The stone may be solitary, or there may be, and commonly are, more stones than one. A stone may be fixed in the ampulla and a second stone, or several, may be wedged in the upper part of the duct, or even in the hepatic duct.

Access to the duct may be obtained in three positions, corresponding to the three divisions of the duct already described.

1. As the duct lies in the free edge of the gastro-hepatic omentum; the supraduodenal portion.
2. As the duct lies behind the duodenum; in the retro-duodenal portion.
3. As the duct lies within the wall of the duodenum; the transduodenal portion.

The operation of choledochotomy consists in the opening of the duct in any of these three positions.

First.—Choledochotomy performed upon the first portion of the common duct. The operation was first suggested by Langenbuch in 1884, first performed by Kümmell in the same year, and first performed success-

fully by Knowsley Thornton in 1889. This is the simplest operation, and in my experience has been that which I have been most frequently called upon to perform.

The position of the patient during the operation is a matter of great importance. All the steps of the operation, up to the suture of the abdominal wound, are simplified by placing a large sand-bag under the patient's back behind the liver, as already described. The table may be slightly tilted so that the feet of the patient are lowered four or five inches, and the head correspondingly raised. Mayo Robson's incision is made,—that is, a vertical incision about five inches in length near the outer border of the rectus,—and an oblique upward and inward prolongation from this about one-half of an inch from the costal margin for about two inches, or more if necessary. The abdomen is opened, the kidney and stomach swabs carefully placed in position, all adhesions carefully separated by gauze stripping or divided and ligatured, the bleeding points being carefully sought and at once ligatured in this, as in all stages of the operation.

The gall-bladder and the edge of the liver are now grasped in the hand, being first covered by gauze, so that a firm grip may be obtained. They are dragged gently but firmly downwards from under the costal margin, and the liver is then rotated so that the posterior surface of the gall-bladder now looks forwards and upwards, and the common duct is stretched and brought much nearer to the abdominal wall. In thin patients the common duct is brought quite on a level with the skin wound; in fat patients this is not possible, but in all the duct is made easy of access. It is possible to explore it thor-

oughly, to incise, and if need be to stitch, it without, as a rule, any difficulty.

The common duct now being exposed is surrounded very carefully with swabs and the position of the stone defined. It will often be found to slip about in the dilated duct, and to be very elusive. This is from some points of view a disadvantage, but it often enables the surgeon to move a stone impacted low down in the duct into the upper and more accessible portion. The stone is now grasped between the index finger and thumb of the left hand, and the duct incised over the stone, the cut being of such size as to permit the easy removal of the stone. With a pair of forceps or with a gall-stone scoop the stone is now dislodged. Immediately after it bile will flow, and this the assistant wipes away at once, before there is time for it to soil the parts around. Such bile is always, or almost always, infected by the *bacillus coli communis*, if not by other organisms. Any other visible stones are removed, and the scoop is passed upwards and downwards along the ducts to explore. It will always be found that the duct is of large size, partly as the result of an old-standing cholangitis, partly perhaps because of the increased tension of the bile therein. The duct will, therefore, be large enough in most cases to admit the finger—and in this way alone can a perfectly satisfactory exploration of the duct be made. A stone that will evade detection by the scoop is at once perceived by the finger. The finger, therefore, should always be passed both upwards and downwards along the duct and a free exploration made. A stone even in the ampulla may, by the conjoined manipulation of the

fingers on the duodenum and a finger within the duct, be coaxed upwards into the duct and removed.

This digital exploration should always be resorted to in common duct stone—but it must be remembered that the duct is a septic tract. A glove finger may, therefore, be put on before the exploration, or the glove on that hand may be changed. After the duct is cleared of stones two courses are open to the surgeon: he may either close the duct by suture, or he may drain the duct by a rubber tube. Each case must be decided as seems best, but, on the whole, it will be found both desirable and necessary to drain.

Drainage of the common duct may be direct or indirect—direct when a tube is introduced into the opening in the duct made for the extraction of the stone, indirect when the duct is sutured and a drain is left in the gall-bladder, or in the stump of the cystic duct, left after removal of the gall-bladder. In some instances one method, in other instances the other, may seem the best. But in nearly all cases drainage by one or other of these methods is imperative. If the common duct is closed by suture and the gall-bladder drained, it is prudent though not always necessary to leave in the wound a wisp of gauze whose end lies against the sutured line.

If drainage is employed, a rubber tube is passed upwards towards the hepatic duct for about an inch. If the opening in the duct is very wide, it may be narrowed by a stitch or two of catgut, introduced by Lembert's method. The tube is stitched in by a single catgut suture, which picks up the wall of the common duct a little outside the edge and passes through the tube. So

long as this stitch holds, and it holds about seven to ten days, the tube will remain in place. In addition to this tube another drain is necessary on the outer side of the duct. For this I prefer a rubber tube, split longitudinally, with a fine gauze wick. The tube lies to the outer side of the duct in the kidney pouch; it may be brought out of the abdominal incision, or made to present in a stab wound in the loin, preferably the former. A third tube to lie to the inner side of the duct is occasionally necessary. The gauze wick projects about two inches from the inner end of these tubes. These tubes are left in from three to ten days, as seems necessary. There is no advantage in removing them early.

If it is deemed prudent, the common duct may be closed by suture. This is done by a continuous stitch of catgut or fine celluloid thread taken from end to end of the incision and introduced in two layers. It is important to avoid wounding or penetrating the mucosa, as any suture which gains access to the lumen of the duct may form the nucleus of a calculus. When the wound is securely closed, a split rubber tube with a gauze wick may be passed down to the duct, as a matter of precaution in the unlikely event of any leakage ensuing.

There does not seem to be any general agreement among surgeons as to the propriety or advisability of adopting drainage after the removal of a stone from the common duct. A discussion was recently held at the Société de Chir. de Paris (Bull. et Mem. de la Soc. de Chir. de Paris, vol. 29, p. 1194) in which several surgeons gave their experience. Michaux in twelve choledochotomies had sutured the duct in all, and the results were

"very satisfactory." A drain was left in contact with the suture line, and in "three or four" there was a slight escape of bile. Quénu had abandoned suture entirely, as second operations, owing to blockage of the duct by the infolded mucosa or blood clot, were sometimes called for. Schwartz considered that suture of the duct might be responsible for certain disasters, and he advised drainage in all cases. Hartmann considered that suture of the common duct was "always unnecessary, and sometimes harmful." In my own early cases I not infrequently stitched the wound in the duct, but in a series of sixteen consecutive cases I have drained the duct and all the patients have recovered.

The whole operation area is now gently wiped with sterile swabs wrung out of salt solution, and the liver is replaced, and the abdominal wound closed in part, or wholly, as may be necessary.

Second. The retroduodenal portion of the duct may be reached from behind by a procedure similar to that employed by Kocher in the "mobilising of the duodenum" as a preliminary to the performance of gastro-duodenostomy. This method was suggested at the German Surgical Congress in 1898 by Haasler. It had been found necessary three times in eighteen operations for stone in the common duct. Oscar Block of Copenhagen has described a similar operation to this. In the very great majority of cases a stone which appears to be fixed in this portion of the duct can be moved upwards into the first portion. The operation to be now described is, therefore, very rarely necessary.

The common duct is exposed in the manner already

described. The parietal peritoneum of the posterior abdominal wall is now incised vertically about one and one-half inches to the right of the duodenum. The fingers are introduced into this incision and the peritoneum stripped up until the duodenum is reached. By dragging gently on the second part of the duodenum, it can be turned over to the left so that its posterior surface is visible. A stone seated in the second portion of the duct can now be felt, and the duct over it incised. This part of the duct is either covered by, or lies in, a groove within the pancreas. The gland must, therefore, be cut, or be separated by blunt dissection. In Haasler's three cases the former procedure was once necessary, the latter twice. Vautrin has suggested the division of the pancreas by means of the thermocautery. After removal of the stone the duct is explored and sutured, and a gauze drain left in the posterior peritoneal wound. A sound healing of the duct without leakage is not likely to occur, the duct being here devoid of any peritoneal investment.

Third. The third portion of the duct including the ampulla may be reached by what is known as *duodeno-choledochotomy*. The duodenum is opened and the termination of the duct in its second portion exposed, and the stone or stones extracted therefrom. The operation was devised and first practised by Dr. McBurney of New York in 1891. The earlier stages of the operation are those which have already been described. The stone impacted in the lower end of the duct or in the ampulla is often elusive, being recognised only after close palpation, and shewing a tendency to slip easily away from the fingers which grasp it. The duodenum is

exposed, and if deeply placed or not easily accessible, it may be freed by a vertical incision in the peritoneum to its right side, as already described. The stone is fixed by grasping it between the thumb and the fingers of the left hand. The duodenum is then opened by a vertical incision about one inch or a little more in length. The edges of this incision are grasped with fine vulsella and held apart. The greatest care is taken to prevent



FIG. 67.—The duodenum opened to shew a stone projecting thereinto from the common duct.

any leakage from the duodenum. The fluid therein is mopped up by swabs, which are at once thrown away. As a rule, the ampulla, with the stone, is seen at once, and the stone may even be visible through the patent orifice. If so, an incision is straightway made through the mucosa, slitting up the lower end of the duct, and the stone is lifted out with a scoop, or the orifice of the ampulla may be dilated by introducing a pair of forceps and widely

separating the blades (Collins's method). If there is any difficulty in locating the ampulla, search must be made for the longitudinal fold, which is generally recognised without difficulty. If the stone is above the ampulla, the lowest part of the duct should be slit up from the ampulla and a scoop introduced. This, with the aid of the finger of the left hand, will generally dislodge the stone at once. The clearance of the duct is recognised by the immediate flow of bile. The duct should then be explored with a scoop or with the finger, and any other stones removed. If any stones are felt higher in the duct, they may be worked downwards by means of the left forefinger and middle fingers passed through the foramen of Winslow, behind the supraduodenal portion of the duct, and the left thumb in front of the duct. Between the fingers and the thumb the duct can be "milked" and any stones forced downwards into the duodenum. There is no need to put any suture in the opened ampulla or duct. The duct lies, at this point, actually in the duodenal wall, and, therefore, there is no risk of leakage. In fact, the leaving of a wide-mouthed termination to the duct probably allows of free drainage of the duct for some period. If, however, the stone lies in the second portion of the duct, sutures must be introduced to fix the opened duct into the duodenum, else will leakage occur, and bile will be poured into the peritoneal cavity. The duodenum is then closed by a double row of sutures, the first taking all the coats, the outer one only the serous coat. The strictest cleanliness is observed throughout the operation, and any soiling from the duodenum thereby prevented. Drainage of the abdominal wound is not necessary.

It will be seen that two distinct methods of removal of stones from the lower end of the common duct through the duodenum may be practised. In the one, the ampulla is dilated or incised, or the third portion of the duct divided, and the stone removed therefrom; in the other, the lower part of the pancreatic portion of the duct immediately above the ampulla is opened. In the former, the third portion of the duct or the ampulla is opened; in the latter, the lower part of the second portion of the duct.

The opening of the ampulla is McBurney's method. Since the duct immediately above the ampulla lies in the wall of the duodenum, there is no opening up of any space outside the duodenal wall by an incision upon a stone lying therein. No suture, therefore, is necessary; the slitting up of the ampulla merely results in the leaving of a wider end to the common duct.

The opening of the second portion of the duct from the duodenum was first performed by Kocher in 1894. In this operation the wall of the duodenum is cut completely through. Immediately outside the duodenum lies the overdilated duct containing the impacted stone, which causes the wall of the duct to be lightly pressed against the duodenum. A part of the pancreas may intervene, but owing to the encroachment of the stone upon the duodenum, it has probably undergone atrophy from pressure, and has become fibrous as a result of chronic inflammation. In the majority of the cases recorded the common duct seemed to lie immediately outside the duodenum. When the duct has been opened by this route, its closure may be effected by suture, or the

wall of the duct may be sutured to the wall of the duodenum in such a manner as to ensure the formation of a choledcho-duodenal fistula. The operation was indeed described by Kocher under the term *choledcho-duodenostomy*. During the manipulations necessary to expose the duct and to liberate the stone the duodenum, duct, and stone, should be grasped between the fingers and thumb of the left hand, in order to prevent the elusive calculus from suddenly slipping away.

After the stone is removed, by forceps or by a gall-stone scoop, bile will flow freely from the opened duct. The scoop should be passed upwards and the whole duct carefully explored, in order to see if other stones are present.

After the completion of the suture line posteriorly the duodenum is closed, and the abdominal wound dealt with in the usual manner.

The following description of this operation is given by Kocher. (Stiles' translation of Fourth Edition, p. 231.)

The operation is as follows:

The stone situated behind the duodenum is fixed with the finger, and after the duodenum has been opened, as above described, at a point opposite to the stone, an incision is made down on to the stone. Whether the incision should be transverse or longitudinal will be determined by the position and shape of the stone. The distended common bile-duct is more likely to be found applied to the duodenum in the whole length of the necessary incision, if the latter be made in the long axis of the stone. In this case also we advise, as does Elliot,

for choledochotomy in general, that the wall of the duodenum and bile-duct right down to the stone should be seized with artery forceps as soon as incised, and, if necessary, a stitch may be passed through the middle of the entire thickness of both edges of the wound, so as to keep up the apposition of the two walls and facilitate a choledocho-duodenostomy, as we have termed the operation, if this be required. After the stone has been extracted, the canal should be probed—with the finger if possible—so that other stones may not be overlooked. Whether the opening is now closed in the ideal way (by a suture through the whole thickness of the wound, with a secondary suture to approximate the mucous edges) or not, must depend upon whether the opening in the papilla is stenosed or not. As a general rule, it will be found advantageous to make sure of a considerable opening where there is a danger of the formation of new stones. If the opening is not required, it will contract of its own accord. A suture should, therefore, be put in all round the opening through the whole thickness of both canals. In Kocher's and Kehr's case, in which this method was adopted, no bad consequences resulted from chance regurgitation of intestinal contents.

The following case, in which Kocher's operation of choledocho-duodenostomy was performed, is related by Thienhaus (*Annals of Surgery*, vol. 36, p. 928):

The patient was a woman fifty-three years of age who had complained for five or six years of severe attacks of epigastric pain. For twelve months, since an extremely acute attack, she had been intensely jaundiced, and had lost during that time 102 pounds in weight. From the sudden onset, the unvarying jaundice, and the absence of swelling of the gall-bladder a diagnosis of complete ob-

struction of the common duct was made, and operation was undertaken.

"A large bag was put under the liver of the patient, and then the abdomen opened by a longitudinal incision on the outer border of the rectus muscle. After freeing some adhesions with the omentum, the gall-bladder and a part of the cystic duct were found transformed into a rocky-like mass of the size of two thumbs, the gall-bladder containing not a drop of fluid. After a large incision into the thickened wall of the gall-bladder, this mass, which appeared to consist of numerous gall-stones welded together, was dug out, and a gauze sponge put into the bladder to avoid oozing into the abdominal cavity during operation. Then a transverse incision through the rectus muscle and the suspensory ligament of the liver was made to gain better access to the region of the common duct. Putting one finger into the foramen of Winslow, and the thumb of the same hand above the common duct, the choledochus was explored. Three concretions were found movable in this duct, and besides that, a hard mass in the retroduodenal portion of the duct. As several manipulations to dislodge this concretion into the supraduodenal portion of the common duct proved futile, the duodenum was incised by a longitudinal incision on the anterior wall. Then, as I could not find the papilla immediately, an incision was made through the posterior wall of the duodenum and choledochus to this immovable concretion, after having brought the movable stones downward to the impacted stone, holding them tightly in this position by the index finger of the left hand introduced into the foramen of Winslow, and the thumb of the same pressing the upper portion of the common duct.

"With some difficulty the incarcerated stone was dug out of its diverticulum, the other stones were easily stripped into the duodenum, the duodenum and chole-

dochus sutured together with four silk sutures (cholechooduodenostomis interna), and then the duodenum on the anterior wall closed in the usual manner. The gall-bladder was drained with a drainage-tube after Poppert's method, and a strip of iodoform gauze put around this tube and down to the suture of the duodenum. The patient made an uneventful recovery; her pulse and temperature were never over 100; the fistula from the gall-bladder closed by itself five weeks after the operation. She left the hospital six weeks after operation, her weight increasing rapidly (thirty-seven pounds in four and one-half months)."

During the performance of operations for gall-stones it may be difficult, it is, indeed, at times impossible, to say whether a stone is present in the common duct. An enlarged lymphatic gland lying in the free edge of the gastro-hepatic omentum may be absolutely indistinguishable by touch alone from a calculus in the first portion of the common duct. It causes a hard, rounded, slightly mobile swelling, in all respects similar to a stone. When, however, the method of rotation of the liver is employed and the duct is brought to the surface, the distinction between the two is readily made.

It is not so much in this first part of the duct that difficulties are likely to occur. It is in the second and third portions of the duct when a stone is present it may, indeed, often is, surrounded by a dense thickening in the head of the pancreas so that in the midst of this tough mass no definite stone can be felt. Or, on the other hand, so dense and resistant a swelling may there be felt that the surgeon may have no doubt that a stone will be found.

Yet on cutting into the swelling, or on introducing a finger into the duct, no calculus is felt. In some instances a small chronic abscess in the head of the pancreas may be opened. Legueu, Schwartz, and others have recorded cases of localised induration of the head of the pancreas, incised in the belief that a stone was present, and until I became familiar with the conditions of chronic pancreatitis I made several such mistakes.

When a stone is impacted in the ampulla of Vater, it may be so small as to be felt with difficulty, or being felt it may be mistaken for a hard, inflammatory, or perhaps malignant nodule in the pancreas. A growth in the ampulla cannot be discriminated from stone until the duodenum is opened. In the only case of carcinoma of the ampulla that I have seen it was thought that the small, hard, rounded lump was calculous, and it was only after slitting up the ampulla that a growth therein was disclosed. Difficulties, therefore, in the recognition and discrimination of stone in the lower end of the duct may arise from (*a*) stones being overlooked, a thickening felt involving the duct and its surroundings being looked upon as due to inflammatory deposit. (*b*) No abnormality being recognised when a postmortem examination or a later operation discloses the presence of a stone. (*c*) A condition supposedly due to calculus being recognised and the duct being directly incised, or the ampulla laid open and the duct probed, with the result that no obstruction is found.

LUMBAR CHOLEDOCHOTOMY.

Access to the common duct may also be obtained by the lumbar route, as was shewn by Braun in 1876. On one occasion Tuffier has performed *lumbar choledochotomy* successfully. The method, however, as a deliberate procedure possesses no conceivable advantages, and may usefully be relegated to oblivion.

Though these operations are described separately for convenience, it must not be considered that they are performed in the academic method here portrayed. In several instances I have simultaneously performed choledochotomy and cholecystotomy, choledochotomy and cholecystectomy, and duodeno-choledochotomy and cholecystotomy or cholecystectomy. One point cannot be too frequently nor too strenuously emphasised, that is, that drainage is the secret of success in gall-bladder surgery; it is always an advantage, often imperative. In cases of cholangitis, as made manifest by fever or jaundice or both, and of pancreatitis, drainage must be practised, and should be maintained for a considerable time.

OPERATIONS FOR IMPERMEABLE OR IRREMOVABLE OBSTRUCTION OF THE COMMON DUCT.

When the common duct is occluded by stricture, or growth, or rarely by inaccessible or irremovable calculus (if indeed such a thing exists), it may be necessary to divert the stream of bile by forming a communication between the gall-bladder or the duct above the obstruc-

tion and some part of the alimentary canal. Anastomoses have been made between the gall-bladder and the stomach, cholecystgastrostomy; with the duodenum or any part of the small intestine, cholecystenterostomy; or with the colon, cholecystcolostomy. The common duct has been united to the duodenum or other accessible part of the small intestine, choledocho-enterostomy. The duodenum is the portion of the bowel selected whenever possible, but where adhesions are binding and inseparable, any accessible portion of the stomach or small or large intestine may be chosen. These operations are rarely practised at the present time. Since the longer incisions have been made and the method of rotation of the liver already described has been practised, the common duct has been more readily accessible, and any obstruction has been more easily overcome. There are very few indications for the operations.

CHOLECYSTENTEROSTOMY.

The operation of cholecystenterostomy was suggested by Nussbaum and first performed by v. Winiwarter in an operation which was performed in six stages on dates from July 20, 1880, to November 14, 1881.

It has been generally agreed that for the purpose of effecting the anastomosis a Murphy's button should be used, and if any mechanical appliance is necessary, certainly none is so good as this. In one case, however, Mayo Robson has found the anastomotic opening made in this way narrowed almost to obliteration. I have only once been called upon to perform the operation, in a

case of chronic pancreatitis (drainage of the gall-bladder is the better operation in this condition). I then adopted the method of simple suture, the stitches being passed in exactly the same manner as in the operation of gastro-enterostomy. The advantage of simple suture is that the



FIG. 68.—*a*, Cholecystenterostomy combined with exclusion of the intestine and end-to-end anastomosis, a method I have once adopted; *b*, cholecystenterostomy combined with entero-anastomosis as suggested by von Mikulicz and Maragliano.

opening may be made of ample size, so that subsequent narrowing or closure need not be feared. If possible, enough of the gall-bladder and of the duodenum should be drawn up into the wound to allow of the application of small intestinal clamps. These will facilitate the operation considerably by keeping the viscera to be sutured

close together without difficulty, and by preventing any leakage from the openings. The two portions to be anastomosed lying side by side, a continuous suture of fine Pagenstecher thread is now introduced along a line at least one inch in length. This suture picks up only the peritoneal and subperitoneal coats. In front of this line of stitches an incision is now made into the gall-bladder and into the intestine, the length being about three-fourths of an inch. The edges of these incisions are now united by a continuous suture of catgut which begins at the one end of the incision, unites the posterior edges of the wounds until the opposite end is reached, and then returns along the anterior edges until the starting-point is reached. The suture is a continuous one, and unites the edges by a through-and-through stitch. The ends of this suture are cut short, and the first needle which has been temporarily laid aside is now resumed and the serous coat united along the anterior margin of the wound, to the point whence it started. Thus there are two continuous sutures which completely surround the opening: an inner one of catgut which picks up all the coats of each viscus, and an outer one of Pagenstecher thread which unites only the serous and subserous coats.

If the duodenum is not accessible, the stomach may be chosen. The records of seven cases of cholecystgastrotomy were collected by Perier in 1902. Of these, six proved successful. The fact that bile is not injurious to the stomach and does not in any way interfere with digestion has been shewn by a case of my own recorded in the *British Medical Journal* (vol. 1, 1901, p. 1136) and by the experiments of Stendel upon dogs.

If the small intestine is selected for the anastomosis, some difficulty may result from the passage of the intestinal contents into the gall-bladder. To overcome this difficulty the operation may be performed after the method suggested by Mikulicz. A loop of the intestine is isolated. The apex of the loop is united to the gall-bladder; the sides of the loop, about four inches away, are united to each other by a lateral anastomosis. The intestinal contents are in this way short-circuited and there is no risk of infection of the gall-bladder from the intestine.

It would, doubtless, be an advantage in cases such as this to perform intestinal exclusion, as well as cholecyst-enterostomy. The small intestine at the point selected would then be divided completely, the proximal end would be united to the side of the distal end, about five inches from the point of division, and the distal end would be closed, or a lateral anastomosis made with the fundus of the gall-bladder. I have operated thus in one case.

CHOLEDOCHOSTOMY.

The operation of choledochostomy, the opening of the common duct and the suture of the margins of the opening to the abdominal wound, is said to have been first performed by Parkes. This, however, is incorrect. It was drainage of the duct that Parkes adopted, the performance of choledochotomy without sutures. The operation of choledochostomy was first performed by Helferich in 1887, subsequently by Ahlfeld, v. Winiwarter, and others. The nature of the operation in the cases of

Helferich and Ahlfeld was only recognised at autopsy; it was believed in both that the distended gall-bladder was being opened. To v. Winiwarter belongs the credit of first deliberately performing the operation knowing what he did. In all the cases recorded the common duct has been greatly, often enormously, dilated behind an obstructing calculus. That the dilatation must be considerable is recognised when we know that in two cases mentioned and in several others the duct has been mistaken for the gall-bladder, or even for a pancreatic cyst. Several remarkable examples of extreme dilatation of the common duct have already been mentioned. The duct may be opened, emptied, and forthwith stitched to the parietal peritoneum and the aponeurosis, or the operation may be done in two stages, the opening of the cyst being deferred until union between the duct and the peritoneum is complete.

In Helferich's case the biliary fistula bled and suppurated, and the patient died about one month after the operation. Ahlfeld's patient died on the eighth day of collapse. Von Winiwarter's patient died six weeks after the operation, of gradual exhaustion due to the generalisation of a malignant growth. The following case is worthy of record as shewing the conditions likely to be met with during operation.

It is recorded by Hamilton Russell (*Annals of Surgery*, vol. 26, 1897, p. 692):

George S., aged eight, was admitted to the Melbourne Hospital for Sick Children March 23, 1897.

On the 18th, five days previously, he became feverish

and ill, and on the next day, the 20th, the mother noticed a swelling of the right side of the abdomen. There was constipation, and the one motion passed during the five days prior to admission was putty-like and offensive; the urine was deeply coloured with bile.

On admission, the patient was a well-nourished child,



FIG. 69.—Case of choledochostomy. Under surface of liver with attached organs: *a*, Gall-bladder laid open; *b*, cyst; *c*, duodenum laid open; *d*, pancreas (Hamilton Russell).

with the history of having enjoyed excellent health up to the onset of the present illness. Jaundice was general and marked; temperature, 102° F.; pulse, 128. Examination of the abdomen revealed the following: The right flank was occupied by a large, tense, elastic tumour, dull on percussion, being continuous with the liver dulness above;

extending downward an inch below the iliac crest, reaching inward nearly to the midline, and posteriorly occupying the entire lumbar region. There appeared to be distinct tenderness on palpation of the tumour; there was a slight increase of the liver dulness upward. A second, smaller tumour projected visibly immediately beneath the rib-cartilage, about the right linea semilunaris; this tumour was rather larger than a pigeon's egg, round, soft, elastic, and painless. Both heart and lung sounds were normal.

The view taken as to the nature of the case was as follows: The larger tumour was believed to be an echinococcus cyst, which had escaped notice until the onset of the present illness; the smaller tumour was either a second cyst or possibly a distended gall-bladder.

Operation on April 8th. The abdomen was opened by a four-inch incision in the right linea semilunaris, extending downward from near the costal margin. The smaller tumour at once presented, and was found to be the gall-bladder distended with colourless contents; there were no adhesions, so that its entire contour could be readily felt. Turning now to the larger cyst, this was found to be retroperitoneal, and the colon was bound to the face of it, being nearer the inner than the outer side of the cyst. An exploring syringe was now used, and perfectly clear, limpid fluid obtained, having all the physical appearance of hydatid fluid. The cyst was next emptied in great part by aspiration and then incised, when three surprising discoveries were made: (1) in the fluid, as it flowed, there came several blackish masses looking like cinders; (2) there was no echinococcus cyst; (3) at the end of the flow the fluid was observed to suddenly change in character, and in place of the clear limpid fluid there came one or two ounces of less clear and distinctly mucinous fluid. It was now ascertained that this mucinous fluid had come from the gall-bladder, which was collapsed, having

emptied into the larger cyst. Thus it was evident that this large retroperitoneal cyst had a communication with the common bile-duct, and the only conclusion I was able to arrive at as the result of much speculation, with which I need not weary the reader, ascribed to the cyst a pancreatic origin; the possibility did not occur to me that in a child of eight, who had never suffered a day's illness until three weeks previously, this enormous cyst could itself be the dilated common bile-duct.

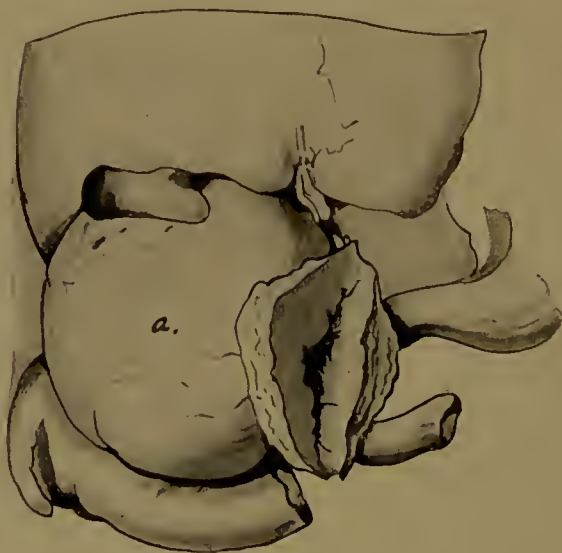


FIG. 70.—Ahlfeld's case of choledochostomy: *a*, The dilated duct stitched to the skin.

The operation was completed by stitching the opening in the cyst to the musculature of the abdominal wall, and closing the abdominal wound. After the operation the whole of the bile commenced to flow from the opening; with the view of ascertaining whether there was any admixture of pancreatic fluid with the bile, its digestive properties were investigated by my colleague, Dr. Stawell, with a negative result, nor was any excess of fat discovered in the stools. The child died four days after

the operation, from hæmorrhage, the result of uncontrollable oozing from the stitches and into the cyst.

Autopsy. The body was universally jaundiced, and had the waxen appearance characteristic of death from hæmorrhage; the cyst was filled by a mass of normally clotted blood, with some bile. On opening the body the intestines appeared to be lightly smeared with blood, and the points of contact of neighbouring coils were marked by lines of blood; all the organs were healthy with the exception of those concerned in the operation. The liver with the system of biliary vessels, including the cyst, the duodenum, pancreas, and spleen, were removed in one piece and are portrayed in the accompanying illustration. The cyst is seen to communicate anteriorly with the gall-bladder, the cystic duct being dilated so as easily to admit an ordinary penholder. At the transverse fissure the dilated hepatic ducts are seen opening into the cyst. The duodenum and the head of the pancreas are spread over the outside of the cyst. A careful search for the terminal portion of the common bile-duct reveals a small valvular opening on the interior of the cyst through which a probe can be passed into the duodenum, on the surface of which it appears through the usual papilla; that this is the normal termination of the common bile-duct is proved by passing a second probe through the same duodenal orifice into the pancreatic duct; this can be easily done. Russell adds, "We may safely conclude that the condition was congenital."

Additional cases are recorded by Edgeworth and others. See chapter on "The General Pathology of Gall-stone Diseases."

CHOLEDOCHO-ENTEROSTOMY.

If the nature of the cyst formed by the dilatation of the common duct can be recognised, it is certainly better to perform an anastomosis between the overdilated duct and the intestine. This operation, choledocho-enterostomy, was first performed by Riedel in 1888. It was Riedel's intention at first to cut across the duct completely and to implant the severed end in the duodenum, but, abandoning this idea, he united by lateral anastomosis the dilated duct to the bowel. The patient died as a result of the leakage of infected bile into the general peritoneal cavity. Kocher in 1890 operated upon a patient in whose common duct two stones were impacted. The duct behind the block was greatly dilated and it was his intention to unite the duct to the duodenum lying in contact with it, and sutures were introduced for the purpose. The obstruction of the duct, however, was relieved by the breaking up of the stones, and the opening, therefore, was not made. Sprengel in 1891 reported the first recovery after this operation, the patient being a woman upon whom he had previously performed cholecystectomy. During the first operation the greatly dilated duct was mistaken for the duodenum, and a calculus felt therein was pushed onwards.

Several operations have been done under the impression that a cholecystenterostomy was being performed—the exact conditions only being made clear at an autopsy.

The anastomosis has been effected either by simple suture or by the aid of mechanical appliances, such as Murphy's button, as in Czerny's case, or Boari's button.

The method of lateral approximation has been always adopted.

The following case is related by Swain (*Lancet*, vol. 1, 1895, p. 743):

On October 12, 1894, I was asked by Dr. Clay to see a girl aged seventeen years who had been brought to him for the first time on the preceding day. She had been ailing more or less for two years. In January, 1894, she became jaundiced, and a swelling formed under the liver. She had been treated by two medical men with mercury and other drugs; but in spite of their treatment the jaundice deepened and the swelling under the liver increased in size. They appear then to have told the parents that nothing more could be done, whereupon Dr. Clay was consulted. The condition of the patient when I saw her was briefly as follows: She was very deeply jaundiced; the urine was the colour of porter. The stools were white. She suffered no particular pain, had not been sick, and throughout her illness neither of these symptoms had been present. She was much emaciated. There was a large abdominal tumour reaching from below the liver to the brim of the pelvis and across the abdomen obliquely, about three inches to the left of the umbilicus. The whole swelling was absolutely dull on percussion, and the merest tap on any part of it produced a thrill of fluctuation. Taking the sum of her symptoms, we had little doubt that it was distended gall-bladder, although the possibility of a hydatid cyst was suggested. I aspirated the tumour with a full-sized aspirating needle, and we immediately perceived the characteristic fluid of distended gall-bladder. As if to make assurance doubly sure, towards the latter end of the aspiration a gall-stone struck the cannula repeatedly, and the click of impact was heard by Dr. Clay, the father, and myself.

The quantity of fluid withdrawn was six pints and one ounce. No evil results followed the aspiration, and I did not see the patient again until October 17th, when I found that the swelling was as large as ever. We then advised that an operation should be performed, and for this purpose she was removed to the private home for patients, and on the following day I operated on her. An incision about four inches long was made a little to the outer side of the right linea semilunaris. The integuments were very thinly spread over the tumour and the peritoneum was rapidly reached and opened. The cyst, being exposed and packed well round with small sponges, was tapped with an aspirating needle. Fluid of the same character as before was withdrawn, but to the amount of seven pints and twelve ounces. On passing the hand into the abdominal cavity the cyst was found to be firmly adherent to the intestine in all directions, the transverse colon being spread out over it. A small opening was now made, sufficiently large to admit the forefinger. The cyst wall was very thin, but tough. Externally, it was of a dark chocolate colour; the cut edge was rather white, and the interior bile stained. On introducing the forefinger after a prolonged search no gall-stone could be found, although, as previously stated, the presence of one could not be doubted. The finger passed upwards and inwards towards the liver into a passage with a crescentic opening, which I believed to be common bile-duct; but a probe passed down far beyond the finger impinged on no stone. Up to this time I had no doubt but that I was dealing with a huge, dilated gall-bladder; but my astonishment may be appreciated when I found, in the course of further investigation as to the relations of the parts outside the cyst, the gall-bladder in its normal position, somewhat pale in colour, undistended by bile, and containing no gall-stones. The question now arose as to what course was the best to pursue. To remove

the cyst was impossible. To stitch it to the parietes seemed to condemn the patient to a perpetual fistula, or, at any rate, to very prolonged drainage. I decided, therefore, to accept the other alternative and to attach the cyst to the intestine. Without much trouble I succeeded in drawing up a good coil of jejunum close to the duodenum. My great difficulty was to get a good surface on the cyst. In order to do this I had to tear through the two layers of the mesocolon, and even then the surface obtained was limited. The cyst was then rapidly attached to the bowel by Murphy's button in the manner described by him. The small original opening made to explore the cyst was closed with Lembert's sutures. The peritoneal cavity, which had been thoroughly well packed with sponges, was now cleansed, and the pouch to the outer side and beneath the liver drained with a Keith's tube. The wound was closed with silkworm-gut sutures.

A case is recorded by Terrier, in which, after the anastomosis of a dilated duct to the upper part of the duodenum, the bile flowed backwards into the stomach and was vomited in large quantities.

A case of choledocho-enterostomy is also recorded by Brenner (*Virch. Archiv*, Nov., 1899, vol. 158, part 2).

The operation of choledocho-duodenostomy has been already described.

CHOLEDOCHECTOMY.

Removal of a portion of the common duct with subsequent suture was performed first by E. Doyen. The case was one of stone impacted in the upper part of the common duct; in extracting the stone the duct was torn

through. The frayed ends were trimmed and the ends sutured over a rubber tube. The figures explain the various steps of the operation.

Kehr records a case in which a stricture of the common duct was excised. The posterior part of the duct alone was united; through the anterior part a drainage-tube was passed upwards to the hepatic duct. The patient

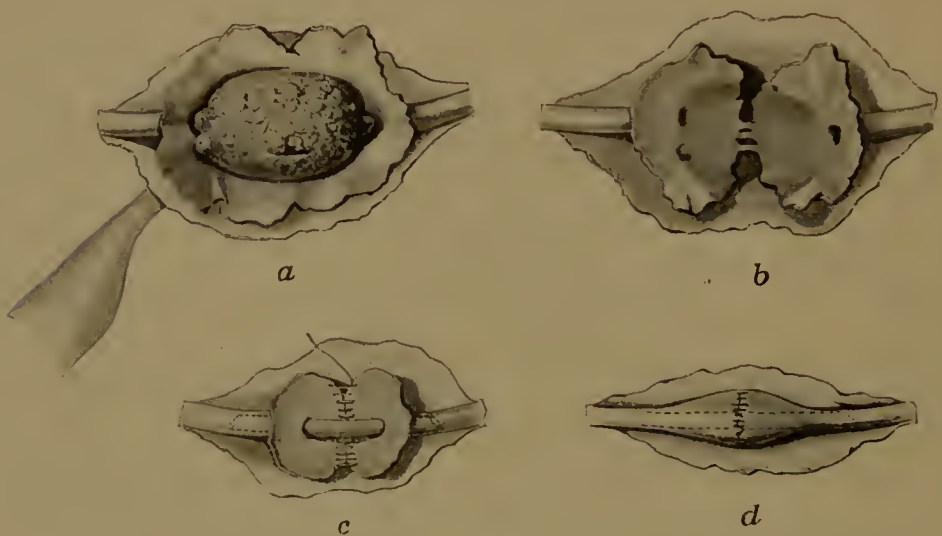


FIG. 71.—Doyen's case of choledochectomy: *a*, Shews the stone in the common duct, just beyond the junction of the hepatic and cystic ducts; *b*, shews the duct ruptured after extraction of the stone; *c* and *d*, the duct sutured after removal of the frayed edges seen in *b*.

recovered, though the hepatic cells were so damaged that no bile flowed through the tube at first; for several weeks a very small quantity only was passed. The fistula eventually closed.

W. J. Mayo (Med. Record, April 30, 1904) records three cases in which portions of the common duct were excised for malignant disease. In the first the gall-bladder, cystic duct, and one inch of the common duct

were excised. The ends of the common duct were brought together in three-fourths of their circumference, the remainder being left open for drainage. The patient recovered. In the second case the proximal end of the divided duct was united to the duodenum. In the third case a malignant tumour of the common duct was excised, with end-to-end suture. This patient died from shock.

Waring and Reynier have successfully performed the operation of excision of a part and of the whole of the common duct in dogs. The operation deserves to be remembered, as in certain exceptional instances it may be necessary.

OPERATIONS UPON BILIARY FISTULÆ.

External Biliary Fistula.—The treatment of external biliary fistulæ will depend entirely upon the conditions which produce and maintain the patency of the external opening. As a rule, with few exceptions, it will be found that the passage of bile through an external fistula is due to the fact that this is the direction of least resistance. If the bile-ducts are clear and free from narrowing, the bile finds its easiest course along them. After a cholecystotomy it is sometimes, as in cases of chronic pancreatitis, advisable to keep the opening patent for several weeks, and to accomplish this is not seldom a matter of the greatest difficulty. If, therefore, the bile-passages are free, an external biliary fistula will close spontaneously.

One form of external biliary fistula mentioned by both Riedel and Langenbuch is that in which a greatly dilated gall-bladder has been drained after cholecys-

totomy. The dragging of the gall-bladder fixed in the abdominal wound produces a kink in the common duct, and the passage of bile to the intestine is therefore prevented. In such circumstances the gall-bladder may, as Riedel advises, be freed and the opening into its fundus sutured. A better plan would be to remove the gall-bladder entirely.

If the fistula persist after the operation of cholecystotomy, it probably indicates that a stone is wedged in the common duct. In this and in all cases it is advisable to make a bacteriological examination of the bile, and to delay any operative intervention until the fluid discharged is almost sterile.

The treatment, therefore, of an external biliary fistula necessitates at the first a very thorough examination of all the bile tract and the discovery of the condition which is responsible for the prevention of the normal flow of the bile into the intestine. If a stone be found in the common duct, it will be removed; if there be a stricture of the duct, it also may be removed or cholecystenterostomy may be performed. If there be a growth or an inflammatory tumour causing obstruction of the duct by pressure from without, or by blockage from within, the fistula may be left as a permanent drain, or a cholecystentcrostomy may be performed. If, after the removal of a stone in the duct, it is quite certain that the duct is clear, the gall-bladder may be removed. Kleiber, in 1892 (Dissert., Greifswald), has collected the records of thirty cases of fistula in which cholecystectomy was performed.

Internal Biliary Fistula.—The discovery of a fistula between the bile passages and the intestine will generally

be made only during the course of an operation. If the fistula connect the gall-bladder or the cystic duct, on the one hand, with the stomach, duodenum or colon, on the other, the two united viscera must be separated with the utmost gentleness. The opening into the intestine is then closed by suture, and the gall-bladder is, by preference, removed, or a drain is introduced through the opening. It is of the highest importance in all such cases to make sure that the passage is clear for the bile. If there is a block in the common duct, it must be removed. As a rule, a stone will be found in the cystic duct, in the common duct near the cystic duct, or in the common duct low down. If choledochotomy is performed, it is wiser to afford through the incision a direct drainage for some days.

Cases of fistula between the bile passages and the urinary tract or the lungs may also be dealt with successfully by operation, the stones which are blocking the hepatic or common duct being removed and free drainage established. Instances are recorded in the chapter dealing with biliary fistulæ.

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